Change in delusions with treatment and the role of reasoning

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Abstract

Background: Delusions are characterised by conviction, distress, preoccupation, and disruption. 'Jumping-to-conclusions' (JTC) and a lack of belief flexibility (BF) have been shown to be associated with delusions.

The thesis: The overall aim was to investigate psychological processes of change in delusions over time and to examine response to treatment of aspects of delusional experience. Specific questions were: do psychological processes associated with delusions change? And do reasoning biases predict change in delusions?

Method: Three longitudinal studies were conducted using three separate samples of patients with delusions of at least moderate severity. Studies 1 (N = 40) and 3 (N = 16) involved patients in an acute phase of psychosis, whereas Study 2 participants (N = 273) were in the recovery phase. Study 1 investigated changes in delusional dimensions, JTC and BF over eight weeks of antipsychotic treatment. Study 2 examined the factor structure and longitudinal relationship of conviction, JTC and BF over 12 months. Study 3 assessed moment-by-moment levels of delusional dimensions, BF and aberrant salience over two weeks using experience sampling methodology.

Results: During the early phase of antipsychotic treatment, all delusional dimensions improved over eight weeks (Study 1), whereas only distress and disruption improved over two weeks (Study 3). BF and conviction were distinct factors (Study 2), and higher flexibility was consistently related to lower conviction. JTC was stable within the study periods, although higher rates of JTC during the acute phase suggest improvement across phases. JTC predisposed to the presence of delusions (Study 2) and was associated with higher and more variable conviction during treatment (Study 3).

Conclusions: That JTC and BF contribute to the development and maintenance of delusions was largely confirmed using longitudinal data. Future research is required to further consolidate the psychological model of delusions and develop effective treatment that involves modifying reasoning biases.

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Statement of contribution

The author was primarily responsible for the conceptualisation, development of research questions and study hypotheses, and determination of study methodology for all the studies for this PhD. The PhD supervisors, Prof. Philippa Garety, Prof. Shitij Kapur and Dr. Emmanuelle Peters, guided the development of the ideas for the research programme and the methodology, analysis and interpretation of findings.

The systematic literature review on treatment response of reasoning biases (Chapter 2) is from a published paper by the author and her supervisors (So, Garety, Peters, & Kapur, 2010). The author determined the inclusion criteria and undertook the literature search. Study 2 (Chapter 4) draws on the sample of the Psychological Prevention of Relapse (PRP) study (ISRCTN83557988), funded by the Wellcome Trust. The PRP study was a multi-centre randomised controlled trial of cognitive behaviour therapy and family intervention for psychosis. Research workers employed on the PRP trial were responsible for recruiting and assessing participants. The author, working with her supervisors and study collaborators, determined the study design, specific hypotheses, measures and methodology. Data analysis was performed by the author in collaboration with Prof. Graham Dunn. This study was published in a paper with the author as the first author and investigators on the PRP trial as co-authors (So *et al.*, 2012).

For Studies 1 (Chapter 3) and 3 (Chapter 5), the author was responsible for seeking ethical approval, designing study protocols, proposing study hypotheses, selecting measures, piloting the studies, and conducting all recruitment and assessment of participants. Study 3 adopted a novel method of assessment, experience sampling method. The author acquired the skills in conducting this kind of research through receiving training from experts in Maastricht, Netherlands, and was responsible for setting up the assessment tools. With technical support from Dr Joel Swendsen, the author was responsible for programming the experience sampling assessment into the personal digital assistants (PDAs) for the participants, transfer of data and management of the database for Study 3.

Data analysis and interpretation of findings for all studies was the work of the author, in consultation with her supervisors and statistical advisors.

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List of abbreviations

AE	Alternative Explanations
AH	Auditory Hallucinations
AIC	Akaike's Information Criterion
ANOVA	Analysis of Variance
ASI	Aberrant Salience Inventory
BADE	Bias Against Disconfirmatory Evidence
BAI	Beck Anxiety Inventory
BDI-II	Beck Depression Inventory – II
BF	Belief Flexibility
BIC	Schwarz's Bayesian Criterion
BPRS	Brief Psychiatric Rating Scale
CBQ-P	Cognitive Biases Questionnaire for Psychosis
CBT	Cognitive Behavioural Therapy
CBTp	Cognitive Behavioural Therapy for Psychosis
CFI	Comparative Fit Index
CGI	Clinical Global Impressions
DIPI	Dimensions of Psychosis Instrument
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders – IV
DV	Dependent Variable
EFA	Exploratory Factor Analysis
EoE	Explanation of Experience interview
ESM	Experience Sampling Method
IPSAQ	Internal, Personal and Situational Attributions Questionnaire
IV	Independent Variable

JTC	Jumping to Conclusions
MADS	Maudsley Assessment of Delusions Scale
MCT	Metacognitive Training
ML	Maximum Likelihood estimator
PANSS	Positive and Negative Syndrome Scale
PDA	Personal Digital Assistant
PDI	Peters *et al*'s Delusions Inventory
PII	Personal Ideation Inventory
PIT	Pragmatic Inference Task
PM	Possibility of being Mistaken
PQ	Personal Questionnaire
PRP	Psychological Prevention of Relapse in Psychosis trial
PSYRATS	Psychotic Symptom Rating Scales
RMSEA	Root Mean Square Error of Approximation
RTHC	Reaction to Hypothetical Contradiction
SANS	Scale for the Assessment of Negative Symptoms
SAPS	Scale for the Assessment of Positive Symptoms
SAT	Salience Attribution Task
SPSS	Statistical Package for the Social Sciences
SUDS	Subjective Unit of Distress Scale
ToM	Theory of Mind
VAS	Visual Analogue Scale
WLSMV	Weighted Least Squares with Mean and Variance Adjustment

General preface to the thesis

The broad aim of this programme of research was to investigate changes in delusions and associated reasoning biases, both in the short and long term with treatment. This thesis begins with an introductory chapter that focuses on the psychological models and assessment of delusions, and reviews the literature on treatment response of delusions. The second chapter is a systematic review of literature on reasoning biases associated with psychosis and their changes with treatment. The three chapters that follow will describe three empirical studies examining changes in delusions and associated psychological processes, over periods ranging from two weeks to 12 months. The thesis will conclude with a discussion of the key findings in relation to the psychological understanding of delusions and treatment implications.

The review on changes of reasoning biases (Chapter 2) and Study 2 (Chapter 4) have been published in Psychosomatic Medicine and Journal of Abnormal Psychology respectively. Therefore, these chapters will be presented as they appear in the journals. Subsequent analyses and discussion of those studies that are relevant to the thesis but were not in the publications will be included in the addendum following the chapter.

Chapter 1

Delusions: Psychological models, assessment and changes with treatment

1.1 Definitions of delusions

Delusions are the most prevalent symptom of psychosis, affecting about one half of all people with a diagnosis of schizophrenia (Sartorius *et al.*, 1986). The phenomenological characteristics of delusions have been the topic of debate for over a century, with key early proposals from the work of Kraepelin (1899), Bleuler (1911), and, especially, Karl Jaspers (1913). Jaspers (1963) considered delusions as fixed, false beliefs that are incomprehensible and held with absolute conviction:

> *"the term delusion is vaguely applied to all false judgements that share the following characteristics to a marked, though undefined, degree: (1) they are held with an extraordinary conviction, with an incomparable, subjective certainty; (2) there is an imperviousness to other experiences and to compelling counter-argument; (3) their content is impossible"* (Jaspers, 1963).

Subsequent descriptions of delusions were also characterised by these qualities: absolute conviction, incorrigibility, lack of amenability to reason, fantastic or inherently unlikely content, and being a belief not shared by the believer's own subculture (Mullen, 1979; Sims, 1988).

This kind of definition poses a number of difficulties. Firstly, the definition of delusion requiring fixity and absolute/extraordinary certainty has been challenged by the empirical evidence that conviction is not absolute (Garety, 1985; Rudden, Gilmore, & Frances, 1982; Strauss, 1969). Clinical rating scales such as the Present State Examination (Wing *et al.,* 1974) and the Psychotic Symptom Rating Scales (Haddock *et al.,* 1999) allow for delusions with a varied degree of conviction. In fact, the level of conviction varies not only between persons, but also within persons, over time and across environments (Brett-Jones, Garety, & Hemsley, 1987; Myin-Germeys, Nicolson, & Delespaul, 2001a; Peters *et al.*, 2011).

Secondly, the view that characterises delusions as having an impossible, 'fantastic or unlikely' content is problematic. Assessment of the possibility of content is arbitrary and studies have reported less than satisfactory inter-rater reliability on ratings of bizarreness (e.g. Kendler *et al.,* 1983; Flaum *et al.,* 1991; Junginger *et al.,* 1992). In addition, there is a wealth of evidence that many people in the general population have delusion-like beliefs and psychotic experiences that resemble delusions in patients with a diagnosis of psychotic disorder, suggesting

that the distinction between normal beliefs and delusions is one of degree, rather than of qualitative difference (see Section 1.2).

There are ongoing debates (e.g. Garety & Hemsley, 1994; Heinimaa, 2002; Jones *et al.,* 2003) about the difficulties of defining delusion. However, the work of this thesis, which is focussed on the study of delusions and cognitive changes over time in the context of treatment, requires an operational definition. One definition which has an acceptable and widely used phenomenological description is that of the Diagnostic and Statistical Manual (DSM-IV; American Psychiatric Association, 2000). It defines delusion as 'A false belief based on incorrect inference about external reality that is firmly sustained despite what almost everyone else believes and despite what constitutes incontrovertible and obvious proof or evidence to the contrary.' However it makes an assumption, not based upon the phenomenology, about 'incorrect inference' which lacks operational criteria and is not necessary for the purposes of the current study. Taking account of the foregoing discussion, the definition of delusion adopted for the present thesis, adapted from the DSM-IV definition, is as follows: a false belief about external reality with marked (though not absolute) subjective certainty which is not ordinarily accepted by other members of the person's subculture and is unresponsive to countervailing evidence.

1.2 Continuity of delusional experience

Using a questionnaire designed to measure delusional ideation in the normal population, the Peters *et al.* Delusions Inventory (PDI), Peters *et al.* (1999) reported a considerable overlap of the ranges of scores between the normal group and the group of individuals who had delusional beliefs, with 10% of their normal sample scoring higher than the mean of the psychotic in-patient group. van Os *et al.* (2001) reported that 4.2% in their community sample of 7000 adults had experienced hallucinations or delusions attested to by a psychiatrist and 17.5% reported at least one experience evoking the concept of psychosis, and yet only 2% of these 1237 individuals had been given a diagnosis of non-affective psychosis. van Os *et al.*'s (2009) meta-analyses reported prevalence rates of positive psychotic symptoms that are around 10 times greater than reported rates for psychotic disorder. In another study of more than 8000 individuals, Johns *et al.* (2004) found that 21.2% of

individuals without a diagnosis of psychosis felt that people were against them at times, 9.1% felt that people had deliberately harmed them, 9.0% felt that their thoughts were directly interfered with or controlled by some outside force/person, and 1.5% feared of a plot. Freeman (2006) reviewed 15 studies and concluded that approximately 1-3% of the non-clinical population had delusions of a level of severity comparable to clinical cases of psychosis. A further 5-6% had a delusion of less severity, which was associated with social and emotional difficulties. In addition, 10-15% had fairly regular delusional ideation (Freeman, 2006).

These findings suggest that delusions and psychotic experiences are not incorrigible phenomena that are categorically distinct from normality. Psychotic symptoms are not uncommon in the general population, and the same demographic and environmental risk factors and clinical variables associated with clinical psychosis are also associated with the occurrence of psychotic symptoms in the non-clinical population (Johns & van Os, 2001; Myin-Germeys, Krabbendam, & van Os, 2003b; van Os *et al.*, 2000). Therefore, it has been argued that psychotic symptoms, including delusions, are better conceptualised as more extreme points along a dimension extending into the general population, sharing similar aetiological factors with the sub-clinical psychotic experiences (Claridge, 1987; Johns & van Os, 2001; Strauss, 1969; van Os *et al.*, 2009).

1.3 Biological and psychological models of psychosis

Researchers have proposed models linking psychosis to multiple biological, psychological and environmental factors. Underlying these models is a stress-vulnerability framework, which assumes that the emergence of symptoms is an interaction between factors that render an individual prone to developing the disorder and factors that impose stress onto the individual, leading to impairment and need for treatment (Cougnard *et al.*, 2007; Nuechterlein & Dawson, 1984; van Os *et al.*, 2009; Zubin & Spring, 1977). This section will include the key factors that have been shown to be associated with the development of psychosis (and delusions in particular), with a focus on reasoning and emotions and their changes.

1.3.1 Biological factors

Vulnerability for psychotic disorders is partly genetic. Heritability estimates for schizophrenia, schizoaffective disorder, and mania are between 82% and 85% (Cardno *et al.*, 1999). McGrath and colleagues (2009) studied the familiality of nine factorial dimensions of schizophrenia in more than 1000 patients. They reported a heritability estimate of 38% for their Schneiderian first-rank symptom factor which consisted mainly of delusions. A number of studies have noted that brain changes as well as cognitive and behavioural deviations, such as developmental delay, cognitive impairments, and social anxiety, are detectable years before the onset of psychosis (Cannon, Jones, & Murray, 2002; Jones *et al.*, 1994; Pantelis *et al.*, 2003). This line of evidence supports the neurodevelopmental theory of psychosis, which postulates that genetic predisposition interacts with non-genetic risk factors in the early development, such as prenatal infection and environmental insults, leading to later emergence of psychosis (Jones & Murray, 1991; Murray & Lewis, 1987; Rapoport *et al.*, 2005).

Onset of psychosis may also be triggered by other biological factors such as substance abuse. Prospective studies have found evidence for a close relationship between cannabis use and heightened risk for psychotic disorders and symptoms (see reviews by Moore *et al.*, 2007; Verdoux & Tournier, 2004). Exposure to cannabis can cause a mild and transient psychotic state, and this effect is stronger in individuals with pre-existing vulnerability to psychosis (D'Souza *et al.*, 2004; Henquet *et al.*, 2005, 2006).

While the neurodevelopmental theory explains the predisposition of some individuals to psychosis, dopamine dysregulation is believed to be the final common pathway linking the abnormality in the brain to the psychological experience of psychotic symptoms (Broome *et al.*, 2005; Howes & Kapur, 2009). According to Gray *et al.*'s (Gray, 1998; Gray *et al.*, 1991) neuropsychological theory of the positive symptoms of schizophrenia, psychosis begins with a structural abnormality in the limbic forebrain, leading to hyperactivity of dopamine transmission, which in turn leads to a cognitive disturbance described by Hemsley (1987, 1993) as "a weakening of the influences of stored memories of regularities of previous input on current perception". Subsequently, the individual fails to

interpret current events using stored past regularities of experience and delusional interpretations therefore arise (Hemsley, 1994a, 1994b).

The key role of dopamine in the pathogenesis of psychosis, on a neuroanatomical and neurochemical level, is supported by a wide range of evidence from brain imaging findings, animal learning studies, post-mortem brains of patients with schizophrenia, and experiments involving amphetamine exposure (see reviews by Gray, 1998; Gray *et al.*, 1991; Howes & Kapur, 2009). On a psychological level, the dopaminergic system is important in mediating attribution of salience whereby events and thoughts come to one's attention, drive action and influence goal-directed behaviour as a consequence of their association with reward or punishment (Berridge, 1999; Berridge & Robinson, 1998). In the state of psychosis, random increases in dopamine release in the mesolimbic pathways are thought to lead to abnormal 'gating' of information into the prefrontal cortex, which conditions the processing of irrelevant information as if it were important and of relevance (Braver, Barch, & Cohen, 1999; Shaner, 1999). Kapur argued that, in psychosis, the hyperactive dopaminergic system fires and releases dopamine independent of cues and context, leading to an aberrant assignment of salience and novelty to external objects and internal representations (Kapur, 2003; Kapur, Mizrahi, & Li, 2005). Therefore, patients experience "a somewhat novel and perplexing state marked by exaggerated importance of certain percepts and ideas", and delusions are "a 'top-down' cognitive explanation that the individual imposes on these experiences of aberrant salience in an effort to make sense of them" and to resolve anxiety (Kapur, 2003, p. 15; Kapur & Mamo, 2003). According to this theory, antipsychotics block dopamine and reduce emotional distress as well as aberrant salience of preoccupying psychotic experiences without modifying the appraisals of experiences, while patients work through their symptoms towards a "psychological resolution" (Kapur, 2004; p. 404; Kapur *et al.*, 2006).

Broome *et al.* (2005) also considered that dopamine dysregulation plays a central role in the onset of psychosis. Taking the neurodevelopmental perspective, Broome *et al.* (2005) suggested that dopamine dysregulation is first determined by genetic predisposition or developmental damage, and then compounded by substance abuse, social adversity and affective change. Subsequently, biased cognitive appraisal processes contribute to the delusional interpretation of abnormal

perceptual experiences. Therefore, neurobiological factors and cognitive/ psychological factors interact to lead to the onset of psychosis.

1.3.2 Psychological models

In the past decade or so, psychologists have identified in greater detail the cognitive and emotional factors that contribute to the development and maintenance of psychosis. These psychological models have a common emphasis on appraisals and the contribution of emotional processes in the aetiology of delusions.

1.3.2.1 Appraisal of experiences

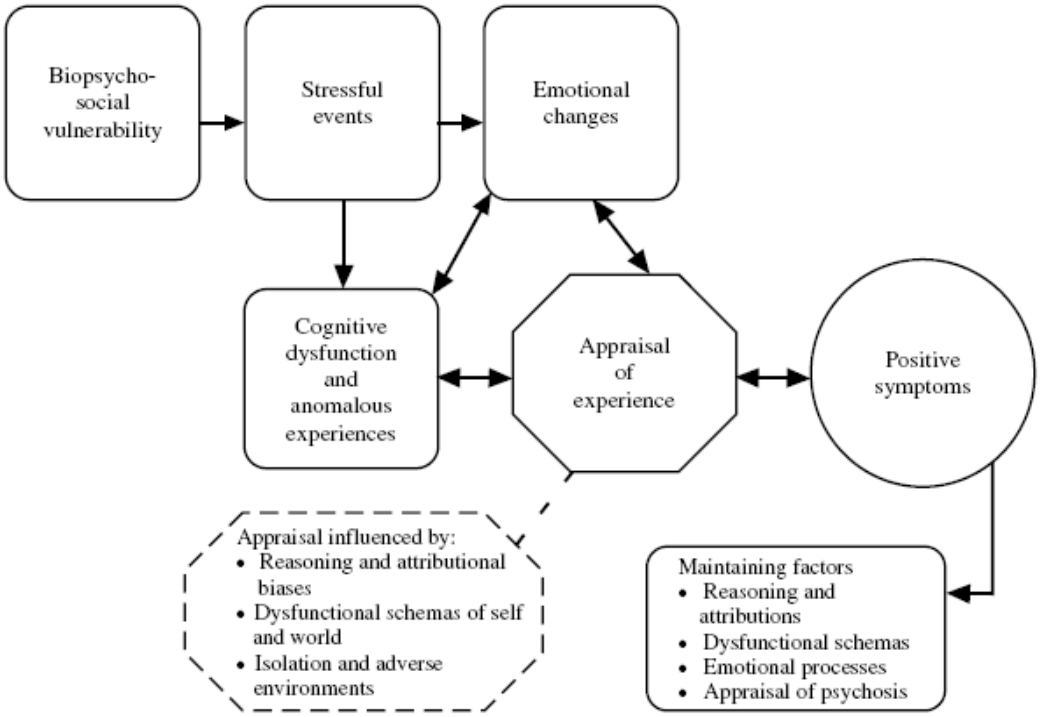
Several cognitive theories of psychosis have suggested that the psychology of psychotic symptoms involves two steps: a state of arousal triggered by a normal or anomalous experience, followed by appraisal or interpretation of the experience. Maher (1974, 1988) suggested that delusions are the result of a search for meaning of anomalous perceptual experiences through normal reasoning processes. Chadwick and Birchwood (1994, 1995; Birchwood & Chadwick, 1997) first suggested that the impact of voices was not necessarily linked directly to voice content or activity, but was mediated by beliefs about them: i.e. voice hearers who interpret their voices as omnipotent and malevolent experience depressed mood and show behavioural resistance towards them. Morrison (1998a) argued that auditory hallucinations, similar to body sensations in panic disorder, are normal psychological phenomena that may be experienced by anybody. However, when 'a normal auditory hallucination' is misinterpreted as threatening to the individual, negative mood and physiological arousal are increased, which then produce more auditory hallucinations. Drawing on cognitive models of anxiety disorders, Morrison (2001) argued that hallucinations and delusions can be conceptualised as intrusions into awareness and that it is the interpretation or appraisal of these intrusions that leads to the associated distress and disability.

Garety and colleagues suggested that basic cognitive processes are disrupted when a triggering event occurs to a predisposed individual, giving rise to anomalous conscious experiences, as well as associated emotional changes (Garety & Hemsley, 1994). These are then followed by an interpretation of the puzzling and distressing

experiences as externally caused and personally significant. It is this external appraisal that provides a necessary condition for psychotic experiences to turn into psychotic symptoms (Garety *et al.*, 2001). A recent study reported that overall levels of psychotic-like experiences did not differentiate individuals who required a "need for care" from those who did not, but the clinical group was more distressed and endorsed more externalising and personalising appraisals (Lovatt *et al.*, 2010). See Figure 1.1 for Garety *et al.*'s (2001, 2007) model.

Figure 1.1

Schematic representation of a cognitive model of the positive symptoms of psychosis (as originally presented in Garety et al., 2001)



1.3.2.2 Psychological processes associated with appraisals

What then influences the interpretation of experiences? Although cognitive models of psychosis differ in their relative emphasis, the following three factors have been considered to contribute to appraisal of experiences directly and in combination: Reasoning biases, mood, and social adversity (including trauma). Reasoning biases associated with psychosis and their response to treatment will be discussed at length in Chapter 2. What is of note here is the 'jumping to conclusions' (JTC) style, the most replicated reasoning bias associated with

delusions, where individuals with delusions and delusion-proneness tend to make decisions based upon gathering less information than controls (Fine *et al.*, 2007; Lincoln *et al.*, 2010). A lack of belief flexibility is another reasoning bias that is closely related to delusions – around two-thirds of individuals with delusions had difficulty considering the possibility of being mistaken about their belief and generating alternative explanations about their experience (Freeman *et al.*, 2004; Garety *et al.*, 2005). Both JTC and lack of belief flexibility have been shown to be associated with delusional conviction, with belief flexibility being a predictor of positive response to cognitive behavioural therapy (Chadwick & Lowe, 1994; Freeman *et al.*, 2004; Garety *et al.*, 1997, 2005; Kuipers *et al.*, 1998). Garety *et al.* (2001, 2005) proposed that, when individuals jump to conclusions based on inadequate data gathering and do not consider the possibility of being mistaken, the delusional belief fails to correct itself and delusional conviction is maintained. An externalising attributional style and theory of mind deficit are other reasoning processes that have been proposed to lead to abnormal inferences of experiences in patients with persecutory delusions (Bentall *et al.*, 2001; Freeman *et al.*, 2002). These will be discussed in detail in Chapter 2.

Mood disturbance plays an integral role throughout the course of psychosis. Mood disturbance predates the onset of psychosis and predicts the transition from the prodrome to frank psychosis (Hanssen *et al.*, 2005; Krabbendam *et al.*, 2005; Yung *et al.*, 2003). Research on the continuum of delusions between clinical and non-clinical populations has found that it is not the content of the delusional beliefs, but the emotional distress attached to them, that differentiates the clinical from the non-clinical individuals (Lincoln, 2007; Peters *et al.*, 1999). In addition, co-morbid diagnoses of mood disorders are common during a psychotic episode (Achim *et al.*, 2011; Braga, Petrides, & Figueira, 2004; Moller, 2005; Turnbull & Bebbington, 2001). Cognitive processes and behavioural characteristics that denote cognitive models of anxiety disorders, such as self-focused attention (Clark, 1999; Ensum & Morrison, 2003), worry (Freeman & Garety, 1999) and safety behaviours (Freeman *et al.*, 2007), are also found in individuals experiencing hallucinations and delusions. According to Freeman *et al.* (2002), these processes play a prominent role in maintaining persecutory delusions. Freeman *et al.*'s (2002) threat anticipation model postulated that the content of the persecutory delusions reflects the emotional

state of the individual, and anxiety is prominent when the persecutory delusion (or threat belief) prevails, involving anticipation of danger. Anxiety-related cognitive and behavioural processes direct the individual's attention to threat-related cues and to discard disconfirmatory evidence, thus maintaining the threat belief (Freeman *et al.*, 2002). Recent evidence of an increase in reasoning biases and paranoia following stress/anxiety manipulation in both patients and healthy participants supports the interaction between reasoning and mood, as suggested in the threat anticipation model of persecutory delusions (Ellett, Freeman, & Garety, 2008; Lincoln *et al.*, 2009; Moritz *et al.*, 2011a). Conceptualising hallucinations and delusions as intrusions into awareness, Morrison (2001) also argued that interpretations of intrusions are maintained by selective attention and avoidance behaviour, as well as meta-cognition about uncontrollability and counter-productive control strategies (Baker & Morrison, 1998; Morrison, 1998a, 1998b; Morrison & Wells, 2000).

Apart from reasoning biases and emotional processes, social adversity and stressful life events, especially trauma and social isolation, may also fuel psychotic experiences and appraisal. The relationship may be direct (Bebbington *et al.*, 2004; Janssen *et al.*, 2004; Larkin & Read, 2008; Lovatt *et al.*, 2010; Morgan & Fisher, 2007; Morgan *et al.,* 2008) or indirect mediated by schemas (Bentall *et al.*, 2001; Birchwood *et al.*, 2000; Fowler *et al.*, 2011). Myin-Germeys (2005) reported an association between subtle psychotic experiences and minor stresses in the daily life of individuals at increased risk of psychosis. Barrowclough *et al.* (2003) also found an association between psychotic symptoms and criticisms by carers and low self-esteem. Extreme negative evaluations of the self and others are associated with the intensity of psychotic symptoms and content of delusional beliefs (Bowins & Shugar, 1998; Close & Garety, 1998; Fowler *et al.*, 2006; Smith *et al.*, 2006). Several cognitive models of psychosis have suggested that negative life experiences may contribute to delusional interpretation of experiences by affecting pre-existing beliefs or schemas about the self and the world (Bentall *et al.*, 2001; Birchwood *et al.*, 2000; Fowler, 2000; Freeman *et al.*, 2002). Using structural equation modelling, Fowler *et al.* (2011) reported a directional relationship from depressed mood and negative cognition to paranoid beliefs, and found that the relationship between depressed mood and paranoia was mediated by negative cognition.

In summary, psychosis is a condition of a multi-factorial aetiology, and it is widely accepted that psychotic symptoms evolve through a complex interplay of the neurobiology and psychology of the individual. Antipsychotics targeting dopamine dysregulation are the first line treatment for psychosis, while cognitive behavioural therapy, targeting reasoning and emotions, is also provided to some patients (NICE, 2009). It has recently been proposed that a combination of pharmacological and psychological treatment domains may promote fuller recovery (van der Gaag, 2006). However, while the cognitive models discussed above are useful in identifying important maintenance factors of delusions, they do not specify mechanisms of change when symptoms remit with medication. What is not known is how the psychological processes associated with delusions respond to antipsychotic treatment. For mood, longitudinal studies have found a reduction of anxiety symptoms following antipsychotic treatment (Depping *et al.*, 2010; Katzman, 2011; Lorenz, Jackson, & Saitz, 2010), whereas evidence for change in depression in response to antipsychotics is mixed (Leucht *et al.*, 2009; Weizman & Weizman, 2001). Schennach-Wolff *et al.* (2011) reported that although depression scores decreased, 23% of patients with schizophrenia were still depressed at discharge. More importantly, response of reasoning biases to treatment is largely under-researched (see Chapter 2). In view of the importance of reasoning biases and emotional processes in the transition to psychosis and maintenance of delusions, investigating the prospective relationship between these processes and delusions during the process of antipsychotic treatment is likely to lead to important treatment implications.

1.4 Assessment of delusions

1.4.1 Multidimensional measures

Factor analyses have shown that the delusional experience is not an all-or-nothing phenomenon but consists of several characteristics or dimensions (Appelbaum, Robbins, & Roth, 1999; Garety & Hemsley, 1987; Kendler, Glazer, & Morgenstern, 1983; Stoll *et al.*, 1980). These dimensions respond to psychological (Brett-Jones *et al.*, 1987; Chadwick & Lowe, 1990, 1994) and, potentially, antipsychotic (Mizrahi *et al.*, 2006) interventions differently, and have differential

associations with other psychological processes such as reasoning biases (Freeman *et al.*, 2004; Garety *et al.*, 2005). The number of dimensions reported ranges from two to seven (Appelbaum *et al.*, 1999, 2004; Hole, Rush, & Beck, 1979; Kendler, Glazer, & Morgenstern, 1983), with a varying degree of inter-correlations between dimensions (Appelbaum *et al.*, 1999; Harrow *et al.*, 2004; Kendler *et al.*, 1983). A number of researchers have concluded that major dimensions in studies investigating delusions and reasoning include conviction, distress, preoccupation and disruption to life (Garety & Hemsley, 1987; Lincoln, 2007; Peters *et al.*, 2004). While conviction is central to the traditional definition of delusions (American Psychiatric Association, 2000; Appelbaum *et al.*, 2004; Harrow, Rattenbury, & Stoll, 1988), recent work on delusional beliefs in clinical and non-clinical individuals has shown that other dimensions, especially distress, may be more relevant than conviction in contributing to patient status (Lincoln, 2007; Peters *et al.*, 1999; van Os *et al.*, 1999). Therefore, multi-dimensional assessment of delusion is important in evaluating treatment outcomes.

Delusional dimensions can be reliably assessed using observer-rated measures such as the Maudsley Assessment of Delusions Schedule (MADS; Buchanan *et al.*, 1993; Taylor *et al.*, 1993, 1994) and the Psychotic Symptom Rating Scales (PSYRATS; Haddock *et al.*, 1999; Steel *et al.*, 2007), as well as self-rated questionnaires such as the Personal Questionnaire (Brett-Jones *et al.*, 1987; Chadwick & Lowe, 1990, 1994; Garety, 1985; Phillips, 1977; Shapiro, 1961) and the Personal Ideation Inventory (PII; Harrow *et al.*, 1988, 2004; Rattenbury *et al.*, 1984). These measures tap into different dimensions of delusions and have been widely used to assess changes in delusional dimensions over time. The Peters *et al.* Delusions Inventory (PDI; Peters *et al.*, 1999, 2004) was designed to assess dimensions of delusional ideation in non-clinical populations.

1.4.2 Experience sampling method

Psychotic experiences are internal phenomena that occur in the realm of daily life, and there has been an increasing research interest in studying psychosis in the context of moment-by-moment interaction between the person and the environment. The experience sampling method (ESM), also known as the

Ecological Momentary Assessment (Collins *et al.*, 1998; Shiffman, Stone, & Hufford, 2008; Stone & Shiffman, 2002), is a structured diary technique, assessing current context and psychological phenomena such as mood in the flow of daily life (Csikszentmihalyi & Larson, 1987; Delespaul, 1995; deVries, 1992; Myin-Germeys *et al.*, 2009; Palmier-Claus *et al.,* 2011b). Participants are assessed in their daily living environment. They typically receive either a digital wristwatch, together with a set of self-assessment forms collated in a booklet for each day, or for computerised ESM, a Personal Digital Assistant (PDA). Multiple times a day on a number of consecutive days, the watch or the PDA emits a signal (beep) at irregular intervals during the day. After each "beep", participants are asked to stop their activity and fill out the ESM self-assessment forms in the booklet or the PDA. The ESM questions are phrased in such a way as to enquire how the participant thinks and feels "at the moment", hence capturing moment-to-moment changes of psychological phenomena in real time. Self-assessments are rated on visual analogue, 7-point Likert (from 1 'not at all' to 7 'very') or bipolar (e.g. -3 to +3) scales, or in the form of open questions. General guidance about how to conduct the ESM assessments is now available (Conner Christensen *et al.*, 2003; Palmier-Claus *et al.*, 2011b).

ESM as a measure of psychological experiences has several advantages (Trull & Ebner-Priemer, 2009). Firstly, it is an assessment applicable in the real world in the flow of daily life, with high ecological validity. Secondly, it is an assessment in the moment, encompassing repeated and micro-longitudinal measurements, which helps to demonstrate fluctuations across time and person-environment interactions and avoids recall bias (Delespaul, 1995; Trull & Ebner-Priemer, 2009). Thirdly, it allows for three levels of variability to be assessed – across beeps, across days, and across individuals. Using statistical procedures involving multi-level modelling (Bryk & Raudenbush, 1987, 1992; Kenny, Kashy, & Bolger, 1997; Kreft & de Leeuw, 1998), researchers can model the influence of within and between-subject factors simultaneously on the variables of interest. Fourthly, ESM minimises the possibility of observer bias and socially desirable answers as the participant enters responses directly into the PDA or booklets in the absence of a researcher.

With the development of software packages, recent studies have conducted the ESM assessments electronically using palmtop computers, or PDAs (Granholm, Loh, & Swendsen, 2008; Kimhy *et al.*, 2006, 2010; Le, Choi, & Beal, 2006; Scharer *et al.*, 2002a, 2002b). In computerised ESM, time-stamped data are stored in the PDA's memory, so that an objective index of compliance is provided and researchers can verify when the participants completed their reports (Conner Christensen *et al.*, 2003). While there is evidence that paper-and-pencil and computerised ESM provide equivalent results (Green *et al.*, 2006; Gwaltney, Shields, & Shiffman, 2008; Jacobs *et al.*, 2005), computerised ESM reduces the chance of human error as data are not entered manually (Barrett & Barrett, 2001). It has also been argued that computerised ESM has better validity because, with booklets, participants may not respond to questionnaires at the appropriate times or may complete them in mass at more convenient times (Broderick *et al.*, 2003; Stone & Shiffman, 2002; Stone *et al.*, 2003), thereby introducing sampling bias into the data. Recent work has shown promise for the use of mobile devices such as mobile phones, PDAs, and "PsyMate" (Myin-Germeys, Birchwood, & Kwapil, 2011) as a methodology for delivering psychological intervention for severe mental illnesses (Depp *et al.*, 2010; Wichers *et al.*, in press).

ESM has been applied with success in studies covering a wide variety of psychiatric conditions, including personality disorders, anxiety and depression, chronic pain, psychosis, and substance abuse (Collins *et al.*, 1998; Delespaul & deVries, 1987; deVries, Delespaul, & Dijkman, 1987; deVries & Delespaul, 1989; Ebner-Priemer & Trull, 2009; Freedman *et al.*, 2006; Glaser *et al.*, 2010; Kimhy, Durbin, & Corcoran, 2009; Lowenstein *et al.*, 1987; Peeters *et al.*, 2003; Stone *et al.*, 2003; Swendsen, 1997; Swendsen *et al.*, 2000; Verdoux *et al.*, 2003). Previous applications of ESM in people with a diagnosis of schizophrenia have demonstrated feasibility, validity, and reliability of the method in patients with psychosis (reviewed by Myin-Germeys *et al.*, 2003a, 2009; Oorschot *et al.*, 2009). Using paper-based assessments in community-dwelling patients with a diagnosis of schizophrenia, studies using ESM have investigated a wide range of aetiological issues including stress reactivity (Myin-Germeys *et al.*, 2000, 2005; Palmier-Claus *et al.*, 2011a), relationships between affect and psychotic symptoms (Delespaul, deVries, & van Os, 2002; Myin-Germeys *et al.*, 2001b; Thewissen *et al.*, 2011),

relationships between self-esteem and paranoia (Thewissen *et al.*, 2008), and gene-environment interactions of the effect of cannabis on psychosis (Henquet *et al.*, 2009).

Using computerised ESM, Granholm, Swendsen and colleagues assessed out-patients with psychosis multiple times a day for one week; they reported a high compliance rate (87%) (Granholm *et al.*, 2008) and found prospective predictive relationships between negative emotional states and occurrence of subsequent persecutory ideation (Ben-Zeev *et al.*, 2011). Kimhy and colleagues applied computerised ESM to in-patients with schizophrenia over a one-day or 36-hours period (Kimhy *et al.*, 2006, 2010), and as an adjunct to cognitive behaviour therapy (Kimhy & Corcoran, 2008). A compliance rate of 60-79% was reported in these studies. In summary, ESM is a well-suited method for understanding fluctuations in psychological phenomenon in the flow of daily life and can be used in patients suffering from severe mental illnesses such as psychosis.

Change in delusions has been examined using ESM with patients in the community. Using items such as preoccupation ("I'm preoccupied by my thoughts right now"), suspicion ("My thoughts are suspicious"), paranoia ("I feel that others might hurt me"), feeling unreal ("I feel unreal") or feeling controlled ("My thoughts are being influenced"), Myin-Germeys *et al.* (2001a) reported that patients with schizophrenia experienced delusions around one-third of the time. However, since the content of delusions differs across individuals, a potentially more effective option may be to use wording that is relevant to the specific content and meaningful to the individual patient. Peters *et al.* (2011) examined key elements of the cognitive models of psychosis, using ESM ratings on the specific content of each patient's delusions. They found that conviction fluctuates over time and that the presence of delusions is associated with more negative affect. ESM will be applied to in-patients during the early stage of antipsychotic treatment for the first time in this thesis.

1.5 Changes in delusional dimensions with antipsychotic and psychological treatment

1.5.1 Response of delusional dimensions to antipsychotic treatment

Two studies have examined changes in delusional dimensions prospectively beginning when patients were hospitalised until after discharge. Using the Personal Questionnaire (Shapiro, 1961), Brett-Jones *et al.* (1987) assessed delusional conviction, preoccupation, and interference weekly, in nine patients, until discharge, or for a maximum of six months. During the study period, the patients received usual psychiatric treatment, including antipsychotic medication. The authors found that preoccupation and interference were correlated with each other, but conviction was not correlated with preoccupation or interference. In addition, they reported a desynchrony of changes between conviction and preoccupation during the six-month assessment period, with a decrease in conviction preceding a decrease in preoccupation. This study was important as it illustrated the possibility of gaining quantifiable data about processes of change from participants with acute delusions through interviews. Replication of the results from the case series would be however required. Using the Personal Ideation Inventory (Rattenbury *et al.*, 1984), Harrow *et al.* (1988) measured changes of conviction in delusions, perspective on delusions, and emotional commitment to delusions in 34 patients at the height of the psychotic episode and after one month of hospitalisation. They reported significant reductions in all three dimensions, although improvement in perspective was smaller than in the other two dimensions after one month of hospitalisation. At the one-month follow-up, patients who received antipsychotic treatment had better perspective and less emotional commitment than patients who were not on antipsychotics.

Although Brett-Jones *et al.* (1987) and Harrow *et al.* (1988) demonstrated the differential changes in delusional dimensions over time, they did not set out to examine the process of change at the early phase of antipsychotic treatment. The initial interview took place within five weeks of admission in Brett-Jones *et al.* (1987) and a median of 26 days following admission in Harrow *et al.* (1988). In Harrow *et al.*'s (1988) sample, only 68% received antipsychotic treatment.

However, examining changes in psychosis during the early phase of antipsychotic treatment is important. For decades, it was accepted that there is delay of two to three weeks between the start of antipsychotic administration and the onset of specific therapeutic benefits, although dopamine receptor blockade is observable in the first few days. This clinical 'delayed onset' hypothesis was challenged by the results of Agid *et al.*'s (2003) meta-analysis which examined data on 7450 patients in 42 double-blind, comparator controlled studies. They reported that core psychotic symptoms improved in all patients within the first week of treatment and that the improvement in psychosis during the first two weeks of treatment was much greater than the improvement observed in any subsequent two-week period (Agid *et al.*, 2003). Leucht *et al.* (2005a) analysed 1708 patients' clinical responses to amisulpiride over time and reported that reduction in psychotic symptoms up to week 2 of treatment was greater than the additional change up to week 4 of treatment. In keeping with the 'early onset' account, Correll *et al.* (2003) found that minimal improvement in positive symptoms during the first week of treatment with a typical antipsychotic predicted poor treatment response after four weeks of treatment (see also Stern *et al.*, 1993). Therefore, assessing patients a few weeks after admission might have missed the period of the greatest change.

Mizrahi *et al.* (2006) was the only study that measured changes in dimensions of psychotic symptoms in the early phase of antipsychotic treatment. They assessed 17 patients at baseline (drug-free) and every two weeks for ten weeks. They reported a modest improvement in conviction six weeks after the start of antipsychotic treatment, which was slower and of a lesser magnitude than the improvement in other dimensions, including behavioural impact and emotional preoccupation. The authors concluded that antipsychotics do not greatly alter patients' conviction in their psychotic experience in the short term (Mizrahi *et al.*, 2006). It should be noted that the semi-structured interview used in this study, Dimensions of Psychosis Instrument (DIPI), had not been used in other studies, and that the dimensions measured were not consistent with the delusional dimensions generated in factor analysis studies (Appelbaum *et al.*, 1999; Garety & Hemsley, 1987; Kendler *et al.*, 1983; Stoll *et al.*, 1980). One of the aims of this thesis was to replicate Mizrahi *et al.*'s (2006) finding of differential changes in conviction and

distress in the early phase of antipsychotics using validated measures of delusional dimensions and experience sampling method.

1.5.2 Response of delusional dimensions to psychological intervention

With the use of multi-dimensional measures, several single-case studies examined changes in delusional dimensions during the course of cognitive therapy. Chadwick and Lowe (1990) measured changes in delusional dimensions in six patients using the Personal Questionnaire (Phillips, 1977; Shapiro, 1961). During the baseline period, conviction and accommodation of alternative explanation were extremely stable, whereas preoccupation and anxiety were highly variable. During psychological intervention procedures (namely structural verbal challenge and a reality test), five out of six patients showed substantial reductions in conviction by the end of the intervention phases, but there was individual variation in whether other dimensions changed at the same time as conviction (Chadwick & Lowe, 1990). Their later study (Chadwick & Lowe, 1994) also showed that most of the patients maintained high and stable conviction at baseline, but reported a reduction in conviction after psychological intervention. Among the ten individuals who reduced in conviction during cognitive therapy, six reported a reduction in preoccupation, anxiety, or accommodation, but there was no reliable measure of the relationship between these changes. In another single-case study series (Sharp *et al.*, 1996), three out of six patients with delusions reported a reduction in conviction during cognitive therapy. While there was some association between conviction and affect at baseline, the two dimensions were not associated during cognitive therapy. Spearman rank-order correlations between conviction and preoccupation were weak across the baseline and therapy phases in two participants (correlation was not determinable for the other four participants as either variable was constant throughout phase). Although these studies were limited by their low samples and a lack of controls, overall this body of work suggests that there is a desynchrony of change amongst the different delusional dimensions during the course of therapy, especially between conviction and affective dimensions.

Several randomised controlled trials have analysed the effect of cognitive behavioural therapy (CBT) on dimensions of delusions, for example Kuipers *et al.* (1997) and Garety *et al.* (2008). Over nine months, Kuipers and colleagues (1997) found that delusional conviction and distress reduced more markedly following CBT compared to treatment as usual. At the 18-month follow-up (Kuipers *et al.*, 1998), the effect of CBT was significant for delusional distress and preoccupation, but not for delusional conviction. Garety *et al.* (2008) reported that, in a sample of recently relapsed individuals, delusional conviction and distress reduced over 24 months in all three conditions – CBT, family intervention, and treatment as usual. In their review, Turkington and Dudley (2004) also reported the role of CBT in reducing distress associated with delusions. In summary, there is evidence that delusional distress improved following months of CBT, while the finding about change in conviction was inconsistent.

1.6 The current thesis – Bridging different modalities of treatment

Recent models of psychosis have suggested that psychosis is multi-factorial in origin (Broome *et al.*, 2005; Garety *et al.*, 2007; van der Gaag, 2006). Among the processes that interact in the pathogenesis, this chapter has discussed the two key approaches of viewing psychosis: (i) a biological-neuro-chemical approach that centres around dopamine dysregulation and the use of antipsychotics; and (ii) a psychological-reasoning approach, focussing on appraisal of experiences and associated emotional processes, and providing a rationale for cognitive-behavioural treatments. While previous research has shown that both antipsychotics and psychological intervention may reduce delusions, the response of psychological processes to these two modalities of treatment and their mechanisms of change remains largely unexplored.

Studies on phenomenology, assessment and treatment of delusions have shown that: (i) delusion consists of several distinct dimensions/characteristics that may change independently over time; (ii) emotional processes such as anxiety are associated with delusions; (iii) psychosis is a state of aberrant salience attribution; (iv) delusions improve with both antipsychotic and psychological interventions, but

over a very different timescale; and (v) emotional aspects of delusions change more quickly than delusional conviction. The critical questions then are: (i) How do dimensions of delusions (i.e. distress, preoccupation, conviction, disruption to life) change over the course of treatment over period of weeks to months? (ii) Do antipsychotics and psychological interventions modify some or all of these dimensions? (iii) How do these dimensions relate to psychological processes such as emotions and reasoning biases? The current series of studies aims to investigate changes in delusional dimensions and the associated cognitive and emotional processes, as well as predictors of changes, during the course of treatment, over shorter (Studies 1 and 3) and longer (Study 2) time periods.

Chapter 2

Reasoning biases associated with delusions and their response to treatment

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2.1 Introduction

Delusions are the most common symptoms of psychotic disorders (Sartorius *et al.*, 1986) and have often been the key targets of treatment. Psychotic disorders are commonly treated with antipsychotics – which are undoubtedly effective for a significant proportion of patients (Kapur & Mamo, 2003) – and most antipsychotic treatment studies have examined the effects of these drugs using objective rating scales that measure positive and negative symptoms. At the same time, most biological investigations of antipsychotics have focussed on examining the effects of antipsychotics on different neurochemical systems using a variety of in-vivo and ex-vivo methods. Thus, most models of how antipsychotics act consist largely of examining the relationship between antipsychotic exposure, symptom reduction and neurochemical changes (Kapur & Mamo, 2003).

On the other hand, psychological studies have reported that people with delusions often display various reasoning biases, the most researched being 'jumping to conclusions', belief inflexibility, externalising attributional style, and a theory of mind deficit (definitions of these terms will be explained in detail in the following section). These reasoning processes have been proposed to play important roles in the development and maintenance of delusions (Garety *et al.*, 2001, 2007), and are targets for change in cognitive behavioural therapy for psychosis (CBTp) (Zimmermann *et al.*, 2005) and the newly emerging reasoning training (Moritz & Woodward, 2007; Ross *et al.*, 2011).

Thus, we have these two models of viewing psychosis – a biological-neurochemical model into which antipsychotics fit in, and a psychological-reasoning model which provides a basis of cognitive-behavioural treatments. Yet, both the modalities lead to an improvement in the same endpoint – psychotic symptoms. The critical questions then are – how do antipsychotics affect reasoning, and how do interventions like CBTp affect neurochemical systems. We focus this review on the former question.

The hitherto divergent foci of studies in the pharmacology/biology and psychology of psychosis have recently converged with the advent of contemporary models of psychosis that explain psychosis in terms of biopsychosocial factors (Broome *et al.*, 2005; Garety *et al.*, 2007; Kapur, 2004; van der Gaag, 2006). These

models explicitly acknowledge the role and presence of reasoning biases in the origin of psychosis – however there is little known or said about the impact of antipsychotics on reasoning biases. Several critical questions arise: Do reasoning biases, which contribute to delusion formation and maintenance, change with antipsychotics treatment? Is the improvement in delusions mediated, moderated or independent of any changes in reasoning biases? This review, therefore, aims to examine the current literature on the relationship between reasoning biases associated with delusions and antipsychotics-induced recovery.

2.2 Reasoning in psychosis

People with psychosis have been reported to have problems with both basic cognitive functions such as attention, concentration and planning as well as biases in reasoning. While there is a wealth of literature on the effect of antipsychotics on cognitive functions such as memory, attention, and executive function (Houthoofd, Morrens, & Sabbe, 2008; Keefe *et al.*, 1999; Sharma, 2002; Woodward *et al.*, 2005), whether reasoning biases respond to antipsychotics is relatively less researched. In this review we will focus on delusions and restrict the analysis to research on reasoning biases in the way individuals interpret experiences, gather information about the world, and develop and maintain beliefs.

2.2.1 Jumping to conclusions cognitive bias (Data gathering)

The "jumping to conclusions" (JTC) bias refers to a tendency to gather less data than controls to reach a decision (see Fine *et al.*, 2007; Freeman, 2007 for reviews). The beads task (Garety, Hemsley, & Wessely, 1991), or its variants, has been used as a measure of JTC in many studies. In the original beads task, individuals are presented with two jars each containing 100 coloured beads. In an easy version of the task, one of the jars contains 85 beads of colour A and 15 beads of colour B, while the other jar contains 85 beads of colour B and 15 beads of colour A. (In more difficult versions the proportion of the different coloured beads are changed, for example, to 60:40.) Individuals are told that beads will be drawn, one at a time, from one of the jars, and are then replaced. They can see as many

beads as they like before deciding which jar the beads are drawn from. The key variable of the beads task is the number of beads seen before making a decision. Extreme JTC responding is defined as reaching a decision after seeing two beads or less (Garety *et al.*, 2005). Variants of the beads task replace beads in a jar with self-referent words (Dudley *et al.*, 1997b), fish in a lake (Woodward *et al.*, 2009), or using four jars instead of two (Moritz *et al.*, 2008). Other JTC studies used alternative tasks such as Wason's 2-4-6 and card selection tasks (Peters *et al.*, 2008) and the 20 questions game (John & Dodgson, 1994; Merrin, Kinderman, & Bentall, 2007).

Recent studies have shown that JTC occurs in one half to two-thirds of individuals with delusions (see Freeman, 2007 for a review). The JTC bias has also been found in people 'at risk' for psychosis (Broome *et al.*, 2007), in people scoring highly on delusional ideation scales (Colbert & Peters, 2002; Linney, Peters, & Ayton, 1998; Moritz & Woodward, 2005; Van Dael *et al.*, 2006; Warman & Martin, 2006) and in people who have remitted from delusions (Moritz & Woodward, 2005; Peters & Garety, 2006). Studies investigating the specificity of the JTC bias showed that JTC (as measured by the beads task) cannot be explained by memory deficit (Broome *et al.*, 2007; Menon *et al.*, 2006), impulsivity (Dudley *et al.*, 1997a; Menon *et al.*, 2006; Young & Bentall, 1997), or general cognitive functioning e.g. Mortimer *et al.* (1996). Therefore, the beads task is considered a specific and reliable measure of the JTC bias.

2.2.2 Belief inflexibility (Evidence evaluation)

Despite the high conviction with which delusional beliefs are held and their apparent incorrigibility, it is interesting to note that there is variation in degree of belief flexibility. Garety *et al.* (2005) reported that almost half (47%) of patients with current delusions showed some degree of acceptance that they might be mistaken in their belief, although fewer (a quarter) are able to actually generate alternative explanations (Freeman *et al.*, 2004). Belief flexibility has been shown to be associated with lower delusional conviction, preoccupation and disruption, but not with delusional distress (Colbert, Peters, & Garety, 2010; Freeman *et al.*, 2004; Garety *et al.*, 2005).

2.2.3 Externalising attributional style

People with persecutory delusions have been found to attribute negative events to external causes (Fear, Sharp, & Healy, 1996; Kaney & Bentall, 1989) or, more specifically, external personal causes (Kinderman & Bentall, 1997). Bentall and others originally argued that delusions function as a defense to protect the individual against low self-esteem (Bentall, Kinderman, & Kaney, 1994; McKay, Langdon, & Coltheart, 2007). However, findings on external attributional bias using attribution questionnaires have been inconsistent and some recent studies have suggested that attributional style is more closely related to affective processes, particularly depression, than to delusions (Fornells-Ambrojo & Garety, 2009; Fowler *et al.*, 2006; Fraguas *et al.*, 2008; Freeman *et al.*, 1998, 2002; Jolley *et al.*, 2006; Smith *et al.*, 2006).

2.2.4 Theory of mind

Frith initially proposed that delusions of persecution and reference arise from an inability to represent the beliefs, thoughts and intentions of other people, a 'theory of mind' (ToM) deficit (Frith, 1992). While psychotic patients with negative and disorganised symptoms have performed worse on ToM tasks, patients with passivity symptoms or patients in remission have performed normally on ToM tasks (Brüne, 2005; Doody *et al.*, 1998; Greig, Bryson, & Bell, 2004; Mitchley *et al.*, 1998; Sarfati & Hardy-Bayle, 1999). It has been suggested that difficulties with ToM may both be a trait factor associated with liability to psychosis (Janssen *et al.*, 2003; Langdon & Coltheart, 1999) and a state factor (Corcoran *et al.*, 1995, 2008; Drury, Robinson, & Birchwood, 1998; Pickup & Frith, 2001).

2.3 Effect of antipsychotics on reasoning – two potential pathways

While there is robust evidence supporting the effect of antipsychotics in reducing psychotic symptoms (Miyamoto *et al.*, 2005), whether these drugs modify any of the reasoning processes related to delusions remains unclear. Two potential models are proposed. In the first model (see Figure 2.1), reasoning biases may exist

before and after a psychotic episode, make the person susceptible to developing psychosis, and limit the effectiveness of the antipsychotics, but not change with antipsychotic treatment. Reasoning would therefore be a moderating factor (Baron & Kenny, 1986) in psychosis, affecting the onset, course of the illness and the effectiveness of antipsychotic treatment; but a change in reasoning would not mediate the effect of antipsychotics.

Figure 2.1

Reasoning biases as a moderator of the relationship between antipsychotics and delusions

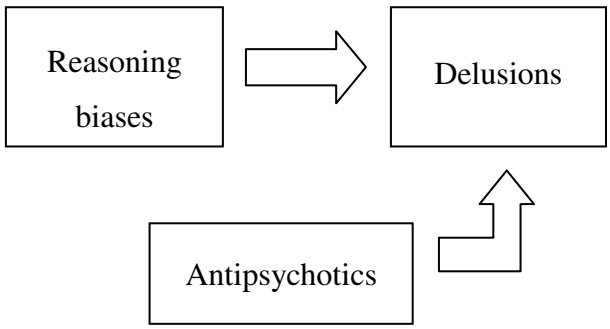
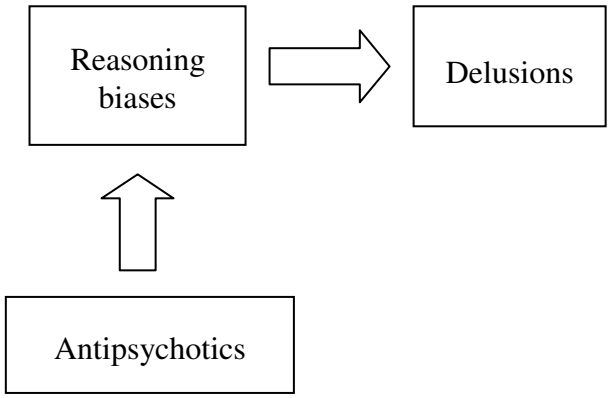


Figure 2.2

Reasoning biases as a mediator of the relationship between antipsychotics and delusions



In the second model (see Figure 2.2), reasoning processes may improve with antipsychotics and act as a mediating factor that acts on the severity of symptoms in

response to antipsychotics: that is, antipsychotics may improve psychotic symptoms through modifying reasoning.

The best way to examine the direct relationship between antipsychotics-induced symptom recovery and reasoning would be an experimental design with careful randomisation of participants into medicated and unmedicated conditions. This is ethically challenging and has never been done with patients with psychosis. Instead, the question of whether reasoning biases normalise in response to antipsychotics in patients with psychosis has been approached indirectly using two quasi-experimental methods. One approach is a longitudinal observational design where the severity of psychosis is 'manipulated' with antipsychotic medication. This type of naturalistic study allows for measurement of changes in psychosis and reasoning before and after antipsychotic treatment takes place. Another indirect approach, which is less powerful, is a cross-sectional design where the relationship between severity of psychosis and reasoning is recorded and analysed across a range of patients with varied symptom severity. This type of study does not necessarily investigate the direct impact of antipsychotics on change of reasoning, but may help to show whether there is a relationship between symptom severity and intensity of reasoning biases.

We systematically review cross-sectional and longitudinal studies on the relationship between reasoning and psychosis, and aim to determine whether reasoning biases respond to antipsychotics and predict treatment response. While there are recent meta-analyses, e.g. Fine *et al.* (2007), and reviews e.g. Freeman (2007) on reasoning processes, the present review is the first to include all the major reasoning processes associated with delusions and to discuss how they change during treatment and symptom improvement.

2.4 Methods

In order to identify systematically any published studies of antipsychotic medication and reasoning in psychosis, we searched on the electronic databases Medline, PsycInfo and EMBASE (from 1806 to May 2009) as well as on PubMed with the following search terms either as key terms or as keywords: "neuroleptic*" or "antipsychotic*", in combination with any of the following reasoning processes

("reasoning", "attribution", "theory of mind", "jumping to conclusions", "need for closure", "belief flexibility", "cognitive bias", "appraisal", "self-serving bias", "confirmatory bias", and "confirmation bias"). The search was limited to literature written in English. A total of 302 papers were generated. It was ascertained from the abstracts that 145 papers were not related to psychosis, and 129 papers were relevant to psychosis but not reasoning, and were therefore eliminated. In order to examine whether reasoning changes with symptomatology of psychosis and during the course of antipsychotic treatment, this review only includes studies that reported and analysed the relationship between severity of psychotic symptoms and reasoning. Out of the remaining 28 articles, 11 studies meet these criteria. Six additional papers were identified through cross-referencing and personal communication. A total of 17 papers are therefore included and discussed in detail in this review. Studies are divided into two broad categories according to their design: (i) studies on reasoning in psychosis with a longitudinal design; and (ii) cross-sectional studies on reasoning in psychosis with data on severity of psychotic symptoms.

2.5 Results

A total of 17 studies were identified that have reported and analysed the relationship between severity of psychosis and reasoning, among which three are longitudinal in design, 11 are cross-sectional in design, and three adopt both cross-sectional and longitudinal analyses.

2.5.1 Longitudinal studies on psychosis and reasoning

There are six studies available that investigated the changes in reasoning in patients with psychosis using a longitudinal observational design. In these studies psychotic symptoms and reasoning were measured when patients were acutely psychotic, and when remitted or according to a fixed follow-up schedule. Three of these studies were on JTC, and one each on belief flexibility, ToM and attribution. Details of these studies are listed in Table 2.1.

Table 2.1.

Longitudinal studies on reasoning in psychosis

Studies	**Diagnoses of patients**	**Sample size**	**Baseline medication status**	**Design/ Period of follow-up**	**Reasoning processes assessed**	**Measures used**	**Findings on the effect of antipsychotics on reasoning**
Brankovic & Paunovic (1999)	Schizophrenia	29 patients 31 anxious patients 35 normal controls	On antipsychotics	Tested while deluded and, in 16 patients with Schizophrenia, also in remission (on average 45 days later)	Evidence evaluation	Probabilistic inference task	The effect of both confirmatory evidence and potentially disconfirmatory evidence on probability judgement was stronger in remission than in the psychotic episode. No correlations between measures of the probability judgement task and psychiatric symptoms
Peters & Garety (2006)	Schizophrenia Schizoaffective/ Bipolar disorder	17 deluded patients 18 psychiatric controls (depression and/or anxiety) 20 non-clinical controls	On neuroleptics, lithium, and antidepressants	Assessed while actively deluded, and when remitted (on average 17.4 weeks in the deluded group, and 33.4 weeks in the psychiatric control	JTC Attributional style	Beads task Pragmatic Inference Task	Probability measures improved with symptom remission, but JTC bias persisted Initial certainty and number of beads drawn are related with delusion symptom scores There was an overall increase (across groups) in self-serving bias at follow-

				group)			up.
Mizrahi *et al.* (2007)	Schizophrenia Schizophreniform disorder Schizoaffective disorder	17 patients	Drug-free, then started on risperidone/ olanzapine/ clozapine/ loxapine	Interviewed at baseline & every 2 weeks up to 6 weeks	ToM	Hinting task	ToM improved with antipsychotics, particularly during the first 2 weeks of treatment No relationship between change in ToM & change in symptoms
Mizrahi *et al.* (2008)	Schizophrenia Schizophreniform disorder Schizoaffective disorder	17 patients	Drug-free, then started on risperidone/ olanzapine/ clozapine/ loxapine	Interviewed at baseline & every 2 weeks up to 6 weeks	Attributional style	Internal, Personal and Situational Attributions Questionnaire	Antipsychotics have little effect on attribution style in 6 weeks, with only a modest effect on externalising bias within 2 weeks Internalising style is associated with poorer response to antipsychotics
Menon *et al.* (2008)	Schizophrenia Schizophreniform disorder Schizoaffective disorder	19 patients	12 drug-free 7 started on atypical antipsychotics at most 48 hrs before the 1st interview after being drug free for at least 2 weeks	Interviewed at baseline, week 2 and week 4	JTC	Beads task Emotionally salient version of the task	Draws to decision increased within 2 weeks of treatment, & remained the same at week 4 Baseline performance on the emotionally salient task predicted symptom improvement in response to antipsychotics No significant relationship between change in delusion/ symptom and change in the number of draws to decision

Woodward *et al.* (2009)	Schizophrenia spectrum disorders	19 patients currently presenting with delusions or hallucinations	On antipsychotics	Assessed before and after 12 weeks of CBT or Symptom Management Training or wait-list period	JTC	Fish task	There is significant negative correlation between change in number of requested pieces of information and change in delusion scores over time. The trend of earlier termination of information gathering from Time 1 to Time 2 is greater in individuals with increasing delusions relative to those with decreasing delusions.

2.5.1.1 Relationship between symptom change and JTC

Using the beads task, Peters and Garety (2006) tested 17 patients, all on medication, while they were actively deluded and when they were remitted (on average after 17.4 weeks). On remission of psychosis, the JTC bias persisted despite an improvement in probability judgements. The authors suggested that the JTC bias is relatively stable and thus may be involved in the formation and persistence of delusion, but does not respond to antipsychotic treatment – consistent with our moderation hypothesis.

Menon and colleagues (2008) measured JTC using the beads task and an emotionally salient version of this task (where comments about a person instead of beads were presented) when 19 psychotic patients began antipsychotic treatment, and at week 2 and week 4. They found that while psychotic symptoms continued to improve at week 2 and week 4, JTC improved (indicated by an increase in draws to decision) within two weeks of treatment and then remained the same at week 4. The improvement was found in the emotionally salient version, but not the neutral version, of the task. While baseline draws to decision predicted subsequent change in positive symptoms, there was no significant correlation between symptom changes and changes in draws to decision. Therefore, the authors argued that JTC was a moderator, and not a mediator, of treatment outcome.

Using a new version of the beads task to enhance task comprehension (where beads in a jar were replaced with fish from a lake), Woodward and colleagues (2009) measured change in JTC behaviour in 19 patients who showed a change in delusions over a period of 12 weeks (four with increasing delusions and 15 with decreasing delusions). They found an overall decrease in number of pieces of information requested at the later time point (i.e. an increase in JTC), which was considered as a repeated testing effect, where individuals request fewer pieces of information at the second testing due to familiarity with the task (Peters & Garety, 2006; Woodward *et al.*, 2009). This earlier termination of information gathering was greater in patients with increasing delusions than in those with decreasing delusions, but this difference did not reach statistical significance, and the sample size in each group was too small for this result to be conclusive.

In summary, available data show that JTC does not improve consistently with symptom improvement, and there is some evidence that baseline JTC predicts outcome (Menon *et al.*, 2008). These data suggest, at best, a moderating, and not mediating role, for JTC on delusion symptomatology. However, there are mixed results on stability of JTC over time. While JTC persists despite further symptom reduction in Peters and Garety (2006), it improves in the emotionally salient version of the task in Menon *et al.* (2008), but worsens in Woodward *et al.* (2009). One possible explanation of such discrepancy of findings is that JTC fluctuates during the state of psychosis. However, most of these studies (except for Peters & Garety, 2006) did not include a control group in the longitudinal analysis, and it is possible that some changes are due to a practice effect of the beads task, as found in the two control groups in Peters and Garety (2006). It is also of note that, in Menon *et al.* (2008), patients were drug-free at baseline and had just begun antipsychotic treatment, while those in Peters and Garety (2006) and Woodward *et al.* (2009) were mainly chronic in-patients who had been on treatment for some time.

2.5.1.2 Relationship between symptom change and belief flexibility

Brankovic and Paunovic (1999) examined reasoning under uncertainty in 29 currently deluded schizophrenia patients (when deluded and in remission), a healthy control group (n = 35), and a group of anxiety patients (n = 31) using a probabilistic inference task. They reported that patients improved in flexible evaluation of their beliefs when they were in remission. The change was similar for evaluation given for both confirmatory and disconfirmatory information. In addition, remitted patients did not differ from healthy participants or anxious patients in the impact of both confirmatory and disconfirmatory evidence on probability judgements. The authors suggested that a less flexible belief evaluation under conditions of uncertainty may be specific to the delusional state of schizophrenia, although within-group variation in psychotic symptomatology did not correlate with reasoning (Brankovic & Paunovic, 1999).

Although not a longitudinal study, Ross *et al.* (2011) investigated the change in delusions and belief flexibility in a randomised experimental study on effect of reasoning training. Seventeen patients with delusions were randomly assigned to one session of reasoning training or attention control. After the training session,

four participants in the reasoning training condition and one in the attention control condition improved in belief flexibility, which was not statistically significant. Delusional conviction reduced in three participants in the reasoning training condition (and none in the control condition). These data tentatively suggest a potential role of belief flexibility change in conviction change, although this small study was underpowered to formally analyse this relationship.

2.5.1.3 Relationship between symptom change and attribution

Using the Pragmatic Inference Task (Lyon, Kaney, & Bentall, 1994), Peters and Garety (2006) measured attributional style in 17 deluded patients when they were actively deluded and in remission, as well as in psychiatric and non-clinical control groups. They found that although the deluded group displayed an excessive self-focus on the PIT at both time points, only a small sub-sample characterised by "bad-me" paranoia showed the expected depressive attributional style, which normalised at follow-up. In another longitudinal study (Mizrahi *et al.*, 2007), 17 patients with psychotic disorders were assessed using the Internal, Personal and Situational Attributions Questionnaire (IPSAQ; Kinderman & Bentall, 1996) when they began antipsychotic treatment and then followed-up for six weeks. Despite significant symptom improvement in the six weeks, attributional style did not change significantly, except for a modest increase in externalising bias within two weeks (Mizrahi *et al.*, 2008). A relationship was also reported between a low self-serving bias and poorer response to antipsychotic treatment, suggesting that an internalising style may play a role as moderator to antipsychotic treatment.

2.5.1.4 Relationship between symptom change and theory of mind

Using a longitudinal design, Mizrahi and colleagues (2007) measured performance on the Hinting Task (Corcoran *et al.*, 1995) in 17 drug-free psychotic patients, and then every two weeks thereafter until six weeks after initiation of antipsychotic treatment. They found that ToM performance improved during the six weeks of treatment, particularly in the first two weeks of treatment. There was no significant correlation between change in ToM and change in symptoms.

2.5.1.5 Summary of findings of the longitudinal studies

Longitudinal studies are useful in informing the relationship between change in symptoms and change in reasoning in response to medication. Despite a vast literature on reasoning in psychosis, only six studies were longitudinal, three of which were conducted by the same research group. The sample size in these studies tends to be relatively small and a control group is often absent, so results based on these studies are preliminary. There is some evidence that belief flexibility and ToM improve over time during the treatment period, although the improvement did not correlate significantly with symptom change. In contrast, there is preliminary evidence that JTC may act as a predictor of subsequent response to antipsychotics, but does not improve with symptom reduction in two of the three studies. Findings on changes in attributional style remain inconsistent, with the study measuring explicit attribution showing no change and the study measuring implicit attribution showing some change.

2.5.2 Cross-sectional studies on psychosis and reasoning

In order to investigate the impact of antipsychotics on reasoning processes, longitudinal studies measuring within-subject changes in reasoning and symptoms are obviously a more direct and sensitive method than cross-sectional studies. Nevertheless, it is still informative to include cross-sectional studies because (i) they are more prevalent in the literature; and (ii) studies comparing between-participant differences in symptom severity and in reasoning characteristics may enhance our understanding of the relationship between symptom severity and reasoning. Therefore, this review includes 14 studies that have reported and analysed the relationship between reasoning and severity of psychotic symptoms (especially delusions) using a cross-sectional design. Six of these studies were on ToM, four each on attribution and belief flexibility, and three on JTC. Details of these studies are listed in Table 2.2.

Table 2.2.

Cross-sectional studies on reasoning in psychosis with data on severity of psychotic symptoms

Studies	**Diagnoses of patients**	**Sample size**	**Baseline medication status**	**Reasoning processes assessed**	**Measures of reasoning**	**Findings on the effect of antipsychotics on reasoning**
Greig *et al.* (2004)	Schizophrenia Schizoaffective disorder	128 patients	Medications not reported	ToM	Hinting task	ToM performance was associated with PANSS positive, negative, and delusion scores, and most strongly with measures of thought disorder
Freeman *et al.* (2004)	Schizophrenia Schizoaffective disorder Delusional disorder	100 patients with current delusions	Medications not reported	Belief flexibility	Maudsley Assessment of Delusions Scale Explanation of events structured interview	Patients who gave alternative explanations had lower delusional conviction than those who did not, but there was no difference in overall severity of psychosis
Garety *et al.* (2005)	Schizophrenia Schizoaffective disorder Delusional disorder	100 patients with current delusions	Medications not reported	Belief flexibility JTC	Maudsley Assessment of Delusions Scale Beads task (neutral & salient versions)	Belief flexibility (possibility to be mistaken) was correlated with PANSS delusion and hallucination scores, but not with PANSS negative or general symptomatology. JTC was associated with delusional conviction, and there was a trend for JTC to be associated with higher PANSS positive symptoms and delusion scores

Peters & Garety (2006)	Schizophrenia Schizoaffective/ Bipolar disorder	23 deluded patients 22 psychiatric controls (depression and/or anxiety) 36 non-clinical controls	On neuroleptics, lithium, and antidepressants	JTC Attributional style	Beads task Pragmatic inference task	Number of beads drawn was inversely correlated with the positive symptom and delusion scores and positively correlated with anxiety. Attributional style was not correlated with any clinical measures at baseline Deluded individuals made significantly more internal attributions overall than the non-clinical participants, but not the psychiatric control group More internal attributions were made for negative than positive events in the depressed group, but not in the deluded or non-clinical groups Individuals with the "bad me" paranoia showed more self-serving bias whereas the "poor me" group showed a depressive attributional style
Diez-Alegría *et al.* (2006)	Schizophrenia Schizoaffective disorder Brief psychotic disorder Bipolar disorder	40 acutely deluded patients 25 remitted deluded patients 35 depressed patients 36 normal controls	On antipsychotic medication	Attributional style	Internal, Personal and Situational Attributions Questionnaire Pragmatic Inference Test	All groups except the depressed group showed an externalising bias for negative events. The personalising bias was significantly greater in the acutely deluded group than in the remitted group. The magnitude of the bias was significantly related to the severity of symptoms. Implicit attributions were more equivocal across groups.
Jolley *et al.* (2006)	Schizophrenia Schizoaffective	71 patients in recent relapse of	Medication not reported	Attributional style	Attributional Style Questionnaire	Patients with persecutory and grandiose beliefs showed an externalising attributional style for negative events

	disorder Delusional disorder	psychosis				Depression was related to a reduced self-serving bias and an externalising attributional style for positive events Persecutory beliefs on their own were not related to any particular attributional style
Woodward *et al.* (2006)	Schizophrenia Schizoaffective disorder	36 actively deluded patients 16 currently not deluded patients (14 with a history of delusions) 24 healthy controls	Medication not reported	Belief evaluation	Bias Against Disconfirmatory Evidence (BADE) task	Currently deluded patients were less responsive to disconfirmatory evidence than currently non-deluded patients for revealed-on-third scenarios, but they were able to integrate confirmatory evidence into their plausibility ratings. BADE was significantly predicted by delusions.
Bömmer & Brüne (2006)	Delusional Disorder	21 patients (10 fully remitted, 5 partially remitted, 6 acutely deluded)	15 patients were on antipsychotics	ToM	Picture sequencing task ToM questionnaire	There was no difference in ToM task performance between fully remitted, partly remitted and acutely delusional patients
Savina & Beninger (2007)	Schizophrenia Schizoaffective disorder	84 patients 24 healthy controls	On Typicals/ Clozapine/ Olanzapine/ Risperidone for at least 4 months Most also on mood stabilisers or other Rx	ToM	1st and 2nd order belief tasks Faux-pas task	The Olanzapine and Clozapine groups performed similarly to Controls, but the Typicals and Risperidone groups did worse than the other groups on ToM tasks

Shamay-Tsoory *et al.* (2007)	Schizophrenia	22 patients 55 controls	On antipsychotics	ToM	Computerised mental inference task	Affective ToM significantly correlated with SANS alogia, SANS attention and SANS total symptoms Cognitive ToM was not associated with SANS scores but correlated with PANSS positive score
Mizrahi *et al.* (2007)	Schizophrenia Schizophreni-form disorder Schizoaffective disorder	71 patients	On atypical (88.6%) and typical (11.4%) antipsychotics	ToM	Hinting task	Performance on the hinting task was correlated with PANSS negative symptoms, PANSS general symptoms and PANSS total score, but not with positive symptoms
Corcoran *et al.* (2008)	Schizophrenia Schizoaffective disorder Delusional disorder Major depression	39 currently paranoid patients 29 remitted paranoid patients 20 paranoid depressed patients 27 non-psychotic depressed patients 33 healthy controls	On antipsychotics	JTC ToM	Beads task Social version of the beads task ToM stories False-belief picture-sequencing task	Patients with current persecutory delusions, across diagnoses, tended to draw conclusions more hastily and score lower on the ToM tasks. JTC did not correlate with severity of delusions. ToM performance on the stories correlated significantly with delusional preoccupation and distress, but that on the picture-sequencing task did not JTC and ToM performance did not correlate with antipsychotic dosage.
Mizrahi *et al.* (2008)	Schizophrenia Schizophreni-form disorder Schizoaffective disorder	86 patients	87% on antipsychotics 13% not on medication	Attributional style	Internal, Personal and Situational Attributions Questionnaire	Patients with less externalising bias had greater overall psychopathology Externalising bias and personalising bias were not associated with delusions

Colbert *et al.* (2010)	Schizophrenia spectrum disorders	17 patients with current delusions 17 patients remitted from delusions 35 non-clinical controls	On antipsychotics	Belief flexibility	Belief maintenance section of the Maudsley Assessment of Delusions Scale	On the personally meaningful beliefs, whether delusions or other idiosyncratic beliefs, there was no group difference in conviction and belief flexibility. On the standard belief, the clinical groups showed less belief flexibility than the control group (with only the remitted group significantly so).

2.5.2.1 Relationship between symptom severity and JTC

There is a wealth of literature on JTC and psychosis, but only three studies systematically analysed the relationship between severity of symptoms and JTC using a cross-sectional design. With a large sample of 100 patients with active delusions, Garety and colleagues (2005) found that JTC correlated significantly with delusional conviction, and that there was a trend for JTC to be associated with higher positive and delusion symptom scores. JTC was not associated with negative or general symptomatology. In another study with 23 in-patients with delusions, Peters and Garety (2006) found that patients with higher delusion and positive symptom scores drew fewer beads before reaching a decision. These studies suggest that JTC is related to severity of positive symptoms, and to delusions in particular. In a large sample consisting of currently deluded, remitted deluded, deluded and depressed, and non-psychotic depressed individuals, Corcoran *et al.* (2008) did not find any significant relationship between performance on the beads tasks and severity of delusions, but current deluded status significantly predicted performance on one version of the beads task. Together with data from longitudinal studies (Peters & Garety, 2006; Menon *et al.*, 2008) and from studies of high-risk or delusion-prone individuals, who show an attenuated JTC (Broome *et al.*, 2007; Colbert & Peters, 2002), the current literature suggests that JTC may be a trait factor associated with propensity for delusions that is exacerbated in acute states of psychotic delusions. This is consistent with Van Dael *et al.* (2006), who found a dose-response relationship between JTC and level of psychosis liability (trait), in interaction with a dose-response relationship between JTC and delusional ideation (state).

2.5.2.2 Relationship between symptom severity and belief flexibility

A comparison of belief flexibility in psychotic patients with varying severity of symptoms has been conducted in four cross-sectional studies. Freeman *et al.* (2004) and Garety *et al.* (2005) assessed 100 patients with current delusions using the Maudsley Assessment of Delusions Scale (MADS; Wessely *et al.*, 1993), where patients were asked about any events and experiences that would support their belief, the possibility of being mistaken, and their reaction to hypothetical contradiction. Freeman *et al.* (2004) measured belief flexibility based on patients'

ability to give alternative explanations of events. It was found that patients with lower belief flexibility had higher delusional conviction (Freeman *et al.*, 2004) and were less likely to reduce their conviction in their belief in response to hypothetical contradiction (Garety *et al.*, 2005). Garety *et al.* (2005) also reported an inverse relationship between belief flexibility and severity of positive symptoms, delusions and hallucinations. Taken together, these results suggest that belief flexibility is related to delusional conviction, and may be related to severity of positive symptoms.

Woodward and colleagues (2006) asked deluded patients, non-deluded patients and healthy controls to rate plausibility of interpretations of scenarios while being presented with an increasing number of items of confirmatory or disconfirmatory evidence. They found that currently deluded patients were less responsive to disconfirmatory evidence than currently non-deluded patients, although they were able to take into account confirmatory evidence in their probability estimates. Such a bias against disconfirmatory evidence (BADE) was significantly predicted by delusions, but not other psychotic symptoms (Woodward *et al.*, 2006).

Colbert *et al.* (2010) assessed belief flexibility on delusions or on personally meaningful beliefs, as well as on a standard belief, in patients with current delusions, patients remitted from delusions, and non-clinical controls. They found no significant group differences in belief flexibility for personally meaningful beliefs or delusions, suggesting that belief flexibility is characteristic of such beliefs. However, on the standard belief, the remitted group showed significantly less belief flexibility than the control group and there was a trend for lower belief flexibility in the deluded group than in the control group. In addition, higher belief flexibility was related to lower delusional conviction in the clinical groups.

These findings, together with findings from the longitudinal study (Brankovic & Paunovic, 1999), suggest that belief flexibility and evaluation of evidence is related to the active delusion state. This result is consistent using delusion-related measures (Freeman *et al.*, 2004; Garety *et al.*, 2005) and delusion-neutral materials (Brankovic & Paunovic, 1999; Colbert *et al.*, 2010; Woodward *et al.*, 2006). The difference in belief flexibility between the remitted group and the control group in Colbert *et al.* (2010) tentatively indicates that belief flexibility may

also be a vulnerability factor. However, this is a small study and the finding is yet to be replicated. Woodward *et al.* (2006) found that such a bias was specific to disconfirmatory evidence, whereas Brankovic and Paunovic (1999) found a similar bias in integrating both disconfirmatory and confirmatory evidence for belief evaluation.

2.5.2.3 Relationship between symptom severity and attribution

The relationship between an externalising attributional style and severity of psychosis was investigated in four cross-sectional studies. Diez-Alegría and colleagues (2006) measured attribution using both explicit (IPSAQ; Kinderman & Bentall, 1996) and implicit (Pragmatic Inference task; Winters & Neale, 1985) measures. On the IPSAQ, the acutely deluded group made more external-personal attributions for negative events (i.e. high personalising bias) than the patients remitted from delusions. Depressed patients also showed a similar level of personalising bias, and the magnitude of the personalising bias was significantly correlated with the severity of psychiatric symptoms as measured by the total score on the Brief Psychiatric Rating Scale (Lukoff, Liberman, & Nuechterlein, 1986). Implicit attribution style, as measured on the PIT, was not significantly different across groups. Using the same implicit attribution measure as Diez-Alegria *et al.* (2006), Peters and Garety (2006) also found no correlation between attributional style and clinical measures. On the other hand, Mizrahi *et al.* (2008) found that patients who had greater overall psychopathology on the Positive and Negative Syndrome Scale (PANSS; Kay, Opler, & Fiszbein, 1987) tended to internalise more for negative events on the IPSAQ, but that there was no specific association between attributional bias and delusions. Therefore, these findings suggest a non-specific relationship between attributional style and general psychopathology on an explicit measure of attribution, although the direction of the relationship is not clear and no relationship was found using an implicit measure of attribution. Jolley *et al.* (2006) compared attributional style in patients with four subtypes of persecutory delusions (no persecutory beliefs, persecutory beliefs only, persecutory and grandiose beliefs, persecutory beliefs and depression). They found that patients with both persecutory and grandiose beliefs tended to make more external attributions for negative events than the not-persecutory or persecutory-depressed groups, while patients with persecutory beliefs and depression tended to make more

external attributions for positive events than the not-persecutory group and showed a reduced self-serving bias. Therefore, the inconsistencies of findings may also be attributed to patient subgroups with different affective and delusional profiles.

2.5.2.4 Relationship between symptom severity and theory of mind

Six cross-sectional studies are available that investigated the relationship between ToM and psychotic symptoms or antipsychotics. Greig, Bryson and Bell (2004) measured ToM using the Hinting Task (Corcoran *et al.*, 1995) where participants were asked to infer the real intentions behind people's speech. They reported that patients diagnosed with disorganised schizophrenia performed significantly more poorly than the other patients with schizophrenia. They also found that ToM performance was correlated with the PANSS positive, negative, and delusion scores, and even more highly correlated with measures of thought disorder. In Mizrahi *et al.* (2007), ToM performance was correlated with PANSS negative, general, and total scores, but not with PANSS positive score. Shamay-Tsoory *et al.* (2007) measured affective and cognitive ToM separately. They found that affective ToM was associated with negative symptoms whereas cognitive ToM was associated with positive symptomatology. These findings suggest that ToM performance is associated with general psychiatric symptoms, but more strongly with negative and thought disorder than positive symptoms.

Two studies have analysed the relationship between ToM performance and delusions in particular. Bömmer and Brüne (2006) compared ToM task performance among fully remitted, partly remitted and acutely delusional patients and found no group differences, suggesting that ToM is not specifically related to severity of delusions. However, Corcoran *et al.* (2008) found that current paranoid status predicted performance on the ToM stories task but not performance on the false-belief picture-sequencing task. More specifically, performance on the stories task correlated with delusional preoccupation and distress (but not conviction), whereas there was no correlation between symptomatology and the picture-sequencing task performance. Therefore, different measures of ToM may be more or less sensitive to indices of severity of delusions and diagnosis.

Savina and Beninger (2007) compared performance on first and second order belief tasks and the faux-pas test among psychotic patients (77 with

schizophrenia and seven with schizoaffective disorder) on different types of antipsychotics (i.e. Typicals, Clozapine, Olanzapine, and Risperidone). Mean score on the Brief Psychiatric Rating Scale (Overall & Gorham, 1962) was highest for the Clozapine group and lowest for the Typicals and Olanzapine groups with the Risperidone group in between. They found that the Olanzapine and Clozapine groups performed similarly to controls in the ToM tasks, while patients on 'typical' antipsychotics and Risperidone had poorer performance. Results stayed the same after co-varying out psychotic symptom scores. The authors argued that ToM performance is influenced by the type of antipsychotics patients are taking. With the caveat that medication groups were not randomly assigned in this study, the effect of different types of antipsychotics on ToM still warrants direct investigation using a randomised design. All in all, Savina and Beninger (2007) and Mizrahi *et al.* (2007) offered some evidence that ToM improves with antipsychotic treatment.

In summary, the relationship between reasoning processes and psychosis is complex. Some cross-sectional studies have shown that severity of positive psychotic symptoms is associated with attributional style, whereas severity of negative and disorganisation symptoms are associated with ToM. Belief flexibility is mainly associated with the delusional state, whereas JTC has been shown to be both a relatively stable trait and exacerbated with delusional state. However, the causal direction of these associations is not clear given the limitation of a cross-sectional design.

2.6 Discussion

In this review, we attempt to bring together the two disparate worlds of the biological-antipsychotic and the psychological-reasoning perspectives of psychosis, by investigating how reasoning biases change during treatment and symptom recovery. The reasoning biases that have been proposed to be related to the development and maintenance of psychosis are JTC, belief inflexibility, attributional style and ToM. Key findings of this review are as follows. Different reasoning processes are related to different symptoms of psychosis. JTC and belief flexibility are closely related to severity of delusions, whereas theory of mind is less related to positive symptoms of psychosis than with negative symptoms and

disorganisation. Attributional style has a less clear-cut relationship with psychosis specifically, with studies using explicit measures showing a non-specific relationship with overall psychopathology (i.e. delusions and depression). In terms of stability over time and changes in response to treatment, there is some evidence that belief flexibility and ToM improve with symptom remission. JTC does not change in the majority of the studies, and the data for attributional style are mixed.

Some methodological issues should be noted. While a large number of studies (28 articles generated using the current search terms) have studied reasoning biases in psychosis – relatively few could be included. The major reason for exclusion was that the majority of the studies have considered schizophrenia as a homogenous group and provided no information on psychosis severity. This is a major drawback in the field and should be addressed in future studies by evaluating and reporting multidimensional symptom severity. To study whether reasoning biases normalise with antipsychotics, the ideal design would be the longitudinal assessment of drug-naïve patients being randomised to different treatment conditions. None of the studies in this review has used such a design. Longitudinal studies available are essentially naturalistic, and are able only indirectly to inform us on the association between change of reasoning and improvement of psychosis. Recent discussions on mediation analysis and causation analysis have specified strategies for designing studies for investigating direct and mediating relationships between variables (Gennetian, Magnuson, & Morris, 2008; MacKinnon, 2008), which would inform future studies on reasoning and psychosis.

Studies that measured different dimensions of psychotic symptoms (e.g. conviction, distress, disruption to life, preoccupation) (Freeman *et al.*, 2008; Garety *et al.*, 2005) have found that some reasoning processes such as JTC and belief flexibility are specifically associated with delusion conviction. Therefore, it is likely that some reasoning processes may be related to specific dimensions of psychotic symptoms rather than to overall severity of symptoms, as reflected on uni-dimensional measures of psychosis like PANSS and Brief Psychiatric Rating Scale. Future research using a longitudinal design and both uni-dimensional and multi-dimensional measures of psychosis will be better able to delineate the role reasoning plays in symptom improvement and in psychological experience of the symptoms.

Despite the limitations of the foregoing literature, the review has three major implications. First, it shows that reasoning biases are distinct and separable, with some (e.g. JTC) likely as fixed 'trait' variables, and others (e.g. belief flexibility) as potential mediating variables which may be relevant in symptom improvement. Second, the review highlights that despite a large number of overall studies, few record symptom severity. Finally, and perhaps most interestingly, it raises the possibility that antipsychotic effect on symptoms may be mediated via effects on intervening reasoning biases such as 'belief flexibility'. Clearly there is insufficient data to be conclusive about this. Nonetheless, the possibility that a psychological construct may mediate a drug induced symptomatic improvement is of significant interest – as it provides a point of contact between biological and psychological theories of psychosis, and also provides a practical rationale for additive and synergistic combination of these treatments. Since both the antipsychotic and psychological modalities of treatment are likely to be further developed in the future – it is important that we understand how the two relate to each other, and also how the improvements induced by both antipsychotics and cognitive-behavioural treatments relate to the more ubiquitous cognitive deficits of the illness. We hope that other researchers will examine and test this possibility more rigorously in future studies.

Preface to the empirical studies

As discussed in this literature review and the introductory chapter, psychological processes including 'jumping to conclusions' (JTC) bias, lack of belief flexibility (BF), and negative affect are important in the development and persistence of delusions. However, what is not known is how these processes change with treatment. This thesis consists of a series of linked studies, using three samples of patients with delusions, which investigate how delusions and reasoning change over time and in response to antipsychotic treatment. Study 1 will examine the differential changes in dimensions of delusions, affect and reasoning biases over eight weeks of antipsychotic treatment (N = 40). Study 2 will examine the factor structure of and longitudinal relationship between delusional conviction, JTC and BF over 12 months, while patients were on antipsychotics with or without psychological intervention (N = 273). Study 3, using experience sampling method and validated clinical measures, will assess moment-by-moment fluctuations and temporal changes in delusional dimensions, affect, BF and aberrant salience in 16 patients over the first two weeks of antipsychotic treatment.

Chapter 3

Study 1: Change in delusional dimensions, JTC, belief flexibility and emotions in the first eight weeks of antipsychotic treatment

3.1 Introduction

Traditionally, delusions have been thought of as unchanging and persistent (Frances, First, & Pincus, 2005; Jaspers, 1963; Mullen, 1979). However, as discussed in Chapter 1, research in the last two decades or more has shown that delusions consist of several dimensions or characteristics which may change independently over time and in response to treatment. Although studies in this area have varied in the number of delusional dimensions and scales used, the major dimensions identified have recurrently consisted of conviction, distress, preoccupation and disruption to life (Garety & Hemsley, 1987; Lincoln, 2007; Peters *et al.*, 2004). This study aimed to investigate these four dimensions using both self-reported and interview-based assessments.

A small number of studies, most of which were of psychological intervention with delusions, have reported changes in delusional dimensions over time. Many of these studies were small single case series during the course of cognitive therapy (eight participants in Hole *et al.* (1979), nine in Brett-Jones *et al.* (1987), six in Chadwick and Lowe (1990), 12 in Chadwick and Lowe (1994), and six in Sharp *et al.* (1996)). Although limited by small sample sizes, these studies suggested a lack of co-variation between delusional dimensions during the course of psychological intervention.

How delusional dimensions respond to antipsychotics – the first-line treatment for psychosis – is under-researched. Since antipsychotic response begins in the first week of treatment (Agid *et al.*, 2003) and early response to medication predicts subsequent outcome (Correll *et al.*, 2003), changes in the first few weeks of treatment are critical. The only study to date that investigated early changes of psychotic dimensions in response to antipsychotic treatment was Mizrahi *et al.* (2006). They suggested that, over the first few weeks of treatment, antipsychotics rapidly reduce the behavioural impact of and preoccupation with the principal psychotic symptom, without greatly altering the patients' conviction in or perspective about their psychotic experience. Nevertheless, this study measured 'principal psychotic experience' rather than delusions and used the Dimensions of Psychosis Instrument (DIPI; Mizrahi *et al.*, 2006), which is not a commonly used scale for delusional dimensions. Using multiple established assessment measures,

the present study aims to investigate changes in delusional dimensions over eight weeks after initiation of antipsychotic treatment, and to explore further Mizrahi *et al.*'s (2006) suggestion of a 'selective' effect of antipsychotics on psychotic dimensions.

As discussed in Chapter 2, there is abundant evidence supporting the association between delusions and reasoning biases, namely "jumping to conclusions" (JTC) and a lack of belief flexibility (BF). It has been shown that a lack of BF is closely related to the delusional state and is likely to improve with symptom remission, whereas JTC may be a trait factor associated with propensity for delusions, which is exacerbated in acute states of psychotic delusions (see Chapter 2; So *et al.*, 2010). However, the empirical literature on psychosis and reasoning largely rests on cross-sectional studies with patients with chronic psychosis. There have been no longitudinal studies on the stability of BF, and only a few on JTC. Therefore, how cognitive processes change in the early stage of antipsychotic treatment is still unknown. The present study is the first to examine changes in JTC and BF in the early stages of antipsychotic treatment.

Apart from JTC and lack of BF, "Beckian thinking biases" (e.g. catastrophising, emotion-based reasoning, dichotomous thinking, etc.) have been shown to be present in patients with psychosis, and are targeted in interventions such as cognitive behavioural therapy (CBT) and metacognitive training (Moritz & Woodward, 2007). The Cognitive Biases Questionnaire for Psychosis (CBQ-P; Peters *et al.*, 2010) was designed to provide a reliable and efficient way of measuring five common cognitive biases associated with delusions. The present study explores changes in appraisals and thinking biases among patients with acute delusions over eight weeks of antipsychotic treatment.

Negative affect, especially depression and anxiety, has been shown to play a role in the development and maintenance of delusions (see Chapter 1). It has been suggested that delusions reflect the emotional state of the individual, and that delusional distress is associated with emotional processes such as worry (Freeman *et al.*, 2001; Freeman & Garety, 1999; Green *et al.*, 2006). However, it remains unclear whether negative affect improves together with delusional dimensions in response to antipsychotic treatment. In the present study, we aimed to investigate changes in delusional dimensions, JTC bias, BF and emotions in the early phase of

antipsychotic treatment in patients with delusions. The key research questions of the study were: (a) What is the impact of antipsychotic medication on dimensions of delusions over time? (b) What reasoning and emotional processes are involved in the antipsychotic-induced recovery process? And (c) What are the predictors of symptomatic improvement?

3.2 Study hypotheses

The major hypotheses were as follows:

1. Delusional distress, preoccupation and disruption will reduce before delusional conviction
2. Depression, anxiety and subjective distress will reduce alongside improvements in delusional dimensions
3. Belief flexibility, but not JTC, will improve with antipsychotics
4. Baseline reasoning biases will moderate changes in delusional conviction

3.3 Method

3.3.1 Participants

Ethical approval for the study was granted by the Camden and Islington Community Research Ethics Committee (ref. 08/H0722/76) and a copy of the approval letter is included in Appendix 1. The sample consisted of adult patients recruited from three in-patient acute wards in the South London and Maudsley (SLaM) National Health Services Foundation Trust, one of which was specifically for patients early in the course of psychosis. Inclusion criteria are as follows: age 15-65 years, case note diagnosis of a psychotic disorder (schizophrenia, schizoaffective disorder, delusional disorder, schizophreniform disorder), current experience of delusions, having been prescribed with any type of antipsychotics for less than four weeks, and having been drug-naïve or drug-free for at least a month prior to admission. Sufficient understanding of English was required to complete the study procedures. Patients with drug-induced psychosis, organic psychosis or a

primary diagnosis of substance misuse were excluded, as their psychopathology might be different from other non-organic psychoses.

The sample size (N = 40) was based both on a statistical power calculation and with reference to previous studies. In a study similar to this, Mizrahi *et al.* (2006) found significant decreases in dimensions of psychosis in 17 patients. However, the present study tested multiple hypotheses, many of which exploratory. Therefore, a sample size of at least double that used in Mizrahi *et al.* (2006) was selected, to increase statistical power. Furthermore, Peters *et al.* (1999) found that patients with delusions had baseline scores of approximately 74 on delusional distress and 88 on delusional conviction on the Peters *et al.*'s Delusions Inventory, with an average standard deviation of approximately 40. It would be expected that, after eight weeks of antipsychotic treatment, distress would reduce by about 20 points and conviction approximately ten points (cf. Mizarhi *et al.*, 2006), hence a differential effect size of 0.6. Based on these data, using a significance level of 0.05 and expecting a power of 95% to reject the null hypothesis, at least 32 participants would be required. Assuming 15-20% of participants drop-out, the aim was to recruit 40 participants in this study.

3.3.2 Measures

Copies of all measures are included in Appendix 3.

3.3.2.1 Clinical symptom ratings

Positive and Negative Syndrome Scale (PANSS) (Kay *et al.*, 1987, 2000). PANSS is a 30-item, 7-point (1-7) rating scale developed for assessing phenomena associated with schizophrenia. Potential total scores range from 30 to 210. Symptoms over the past week are rated. PANSS has four scores: positive (seven items), negative (seven items), general psychopathology (16 items), and total (30 items). It has been reported that each item within the positive and negative scales correlates strongly within the scale total (Kay *et al.*, 1987), and that inter-rater reliability is between 0.83 and 0.87 for the four scales (Kay, Opler, & Lindenmayer, 1988). PANSS is widely used in treatment studies and is considered the 'gold standard' measure in efficacy studies of antipsychotic medication (Rabinowitz, Mehnert, & Eerdekens, 2006). See Appendix 3 (p. 271) for the scale

items.

Clinical Global Impressions (CGI) (Guy, 1976). CGI describes a patient's overall clinical state as a global impression by the rater. It consists of a severity of illness item ("Considering your total clinical experience with this particular population, how ill is the patient at this time?") and a global improvement item ("Compared to his/her condition at admission to the hospital, how much has the patient changed?"). Clinical impression on the day of assessment is rated. The severity score ranges from 1 (normal/not ill) to 7 (among the most extremely ill patients), and the improvement score ranges from 1 (very much improved) to 7 (very much worse). Despite its brevity, CGI is considered to provide more readily understood clinical information than PANSS (Nierenberg & DeCecco, 2002). In this study, CGI was rated by the psychiatrist in charge of the day-to-day care of the participant. See Appendix 3 (p. 263) for the CGI items.

3.3.2.2 Dimensions of delusions

Three measures, one interviewer-rated and two self-report, were included to assess the most important variables in this study – delusional dimensions.

Psychotic Symptom Rating Scale (PSYRATS) (Haddock *et al.*, 1999). PSYRATS is a semi-structured interview measuring psychological dimensions of hallucinations and delusions. The auditory hallucinations scale has 11 items (including frequency, intensity, duration, distress, negative content, disruption and beliefs about origin and control), and the delusions scale has six items (including conviction, distress, preoccupation, and disruption to life). The items are rated by the interviewer on a 0-4 ordinal scale. Potential total scores range from 0 to 44 for the auditory hallucinations scale, and from 0 to 24 for the delusions scale. High inter-rater reliability estimates of the two subscales have been reported (Haddock *et al.*, 1999), and the PSYRATS scales have been used as outcome measures in clinical trials aimed at evaluating the effectiveness of psychological interventions for psychosis (Durham *et al.*, 2003; Garety *et al.*, 2008; Lewis *et al.*, 2002). Since symptom dimensions can change independently during therapy (Brett-Jones *et al.*, 1987; Chadwick & Lowe, 1994), and there is a need for reliable factors reflecting the symptom dimensions, it is preferable to report the PSYRATS data with reference to key single items of relevance to particular

research questions (as well as the total cumulative scores) (Freeman *et al.*, 2004; Steel *et al.*, 2007). See Appendix 3 (p. 272) for the PSYRATS items.

Personal Questionnaire (PQ) (Shapiro, 1961). PQ is a technique that measures changes in psychological experiences using the patient's own words, and allows for comparisons between different variables within the same patient (Shapiro, 1961). A different personal questionnaire is constructed for each patient so that the questionnaire reflects the idiosyncratic nature of the patient's experience. The PQ technique has been used in other studies that have investigated changes in delusional dimensions (Brett-Jones *et al.*, 1987; Chadwick & Lowe, 1990, 1994; Garety, 1985; Sharp *et al.*, 1996).

In the first interview, the statements in PQ were jointly decided between the participant and the interviewer. For example, for the 'distress' item, the interviewer discussed with the participants how they would describe their emotional reaction to the delusional belief (X). The wording that participants chose was then incorporated into the question and used in subsequent assessments: "When thinking about X I feel distressed/angry/fearful/worried/restless/frustrated, etc". For each of the four dimensions (conviction, distress, preoccupation, and disruption to life), participants were asked to choose from five statements which represent varied levels of intensity, and were scored from 0 to 4. For example, for disruption to life, 4 – "X affects my life completely"; 3 – "X affects my life greatly"; 2 – "X affects my life quite a bit"; 1 – "X affects only some parts of my life"; and 0 – "X doesn't affect my life (anymore)". See Appendix 3 (p. 270) for the PQ items.

Visual analogue scale (VAS). Using the same wordings as in PQ, the participant was asked to rate the intensity of each of the four delusional dimensions on a 0-100 visual analogue scale. For example, "How strongly do you believe in X?", "To what extent do you feel angry when thinking about X?" While both PQ and VAS share the same items and are sensitive to the idiosyncratic nature of the individual's delusions, VAS provides a continuous measure of the dimensions and has a broader range of ratings. See Appendix 3 (p. 270) for the VAS items.

3.3.2.3 Reasoning

Belief Maintenance section of the Maudsley Assessment of Delusions Schedule (MADS) (Wessely *et al.*, 1993; Taylor *et al.*, 1994). The complete MADS has eight sections and is an in-depth standardised interview covering various aspects of delusional phenomenology and action, including conviction, belief maintenance, affect, action, preoccupation, systematisation, and insight. The belief maintenance section of MADS enquires about the evidence for the delusion, and two of its items have been used to measure aspects of belief flexibility (the possibility of being mistaken [PM], and the reaction to hypothetical contradiction [RTHC]). These items were originally devised by Brett-Jones *et al.* (1987) to assign change over time in single cases, and have been used in more recent studies (Garety *et al.*, 2005; Freeman *et al.*, 2004). The evidence for the delusion cited by participants is discussed sensitively, and they are asked whether it is *at all possible* for them to be mistaken about their delusional belief. The interviewer then asks how they would react in a hypothetical situation if some new evidence were to be generated which contradicts the delusion. If they report that this would alter their belief in any way, this is recorded as belief flexibility, each item scored dichotomously (yes/no). MADS has very good inter-rater reliability (Wessely *et al.*, 1993), and kappas for these two items have been reported as excellent (PM: kappa = 0.91; and RTHC kappa = 0.90). See Appendix 3 (p. 269) for the scale items.

Cognitive Biases Questionnaire for Psychosis (CBQ-P) (Peters *et al.*, 2010). CBQ-P was designed to measure respondents' misinterpretation of events, or thinking biases. These include dichotomous thinking, emotional reasoning, catastrophising, intentionalising and jumping-to-conclusions. CBQ-P consists of 30 items, each describing a hypothetical scenario in day-to-day life, half of which relate to 'threatening events', and the other half to 'anomalous perceptions'. Respondents are asked to choose from a list of three explanations as to why that scenario happened, which are scored as 1 (absence of bias), 2 (presence of bias with some qualification), or 3 (presence of bias). The potential range of scores is between 15 and 90. In a pilot study with patients with psychosis and depression, as well as healthy participants, CBQ-P showed good internal consistency ($\alpha = 0.89$), test-retest reliability ($r = 0.92$), and criterion validity (Peters

et al., 2010). See Appendix 3 (p. 264) for the scale items.

Beads task (Garety, Hemsley, & Wessely, 1991). The beads task was designed to examine individuals' data-gathering reasoning style (Garety *et al.*, 1991; Phillips & Edwards, 1966). In the beads task, individuals are presented with two jars, each containing 100 coloured beads. In one (easy) version there are 85 beads of one colour (e.g. black) and 15 beads of another (e.g. yellow) in one jar, while the other jar contains beads in opposite proportions (i.e. 15 black and 85 yellow). In a more difficult version the proportion of the different coloured beads are changed from 85:15 to 60:40 (Dudley *et al.*, 1997a). The jars are then removed from view. Upon request from the participant, beads are presented, one at a time, from one of the jars in a seemingly random (but in fact predetermined) order. All the beads drawn are replaced so the proportions of the coloured beads stay the same. Participants can view as many beads as they want until they decide with certainty from which jar the beads are drawn. The key variable is the number of beads requested before making a decision, with two beads or fewer classified as a 'jumping to conclusions' bias (Garety *et al.*, 2005). In this study, the harder 60:40 version (i.e. 60 beads of one colour and 40 of another colour in a jar) was used, since it is more sensitive to change than the easy version. The beads task was presented on a laptop computer. In order to minimise memory load on the participants, an array of the previously drawn beads was shown throughout the task (as in Dudley *et al.*, 1997a).

Cards task (Linney & Peters, 2007). This task was used to assess specific core beliefs by looking at participants' appraisals of a real-life anomalous experience (i.e. a card trick). This trick was adapted from a task that is available on the Internet (http://sprott.physics.wisc.edu/pickover/esp2.html). In this computerised task, the participants are shown six playing cards (all face cards), from which they are asked to choose one and commit it to memory. They are then told that the card they have chosen would be selected and removed from the pile. Once they have pressed a key to continue, they are briefly shown a series of five cards (also all face cards). This trick relies on the fact that people only scan for the card they have chosen and do not notice that all the cards are different.

Following the presentation of the card trick, the participants are initially asked an open-ended question about their explanation of the task (in order to avoid

priming): "Why do you think it happened?". They are then asked to rate their conviction on a visual analogue scale (0-100) for six probed explanations characterising different beliefs. While the explanations originally used in Linney and Peters (2007) focused on mind permeability, the card trick task included six new questions in this study, tapping into appraisals of mind permeability, persecution, intentionality, and personalisation. See Appendix 3 (p. 262) for the questions. Participants are asked to rate how much they believe in each of the explanations, and whether they think the explanations apply to them only or to everybody else.

3.3.2.4 Emotion

Beck Depression Inventory – II (BDI-II) (Beck, Steer, & Brown, 1996). BDI-II is a 21-item self-report inventory that assesses symptoms of depression. The symptom content of BDI-II reflects the diagnostic criteria for major depressive disorders that are described in the Diagnostic and Statistical Manual of Mental Disorders – IV (DSM-IV; American Psychiatric Association, 1994). Participants are asked to rate for the past week. Each item is scored on a four-point scale (0-3). Scores can range from 0 to 63, with higher scores reflecting greater symptom severity (0 to 13 = no to minimal depression, 14 to 19 = mild depression, 20 to 28 = moderate depression, and $\geq$ 29 = severe depression) (Beck *et al.*, 1996). BDI-II has been found to demonstrate high internal consistency (α = 0.92 to 0.93), adequate validity and diagnostic discrimination (Beck *et al.*, 1996). See Appendix 3 (p. 261) for the BDI-II items.

Beck Anxiety Inventory (BAI) (Beck *et al.*, 1988). BAI is a 21-item measure designed to assess the severity of self-reported physiological manifestation of anxiety. Each item describes a common symptom of anxiety. On a four point scale ranging from 0 ("not at all") to 3 ("severely – I could barely stand it"), the respondent is asked to rate how much he/she has been bothered by each symptom over the past week. The total score ranges from 0 to 63. Beck *et al.* (1988) reported a high internal consistency (α = 0.92) and satisfactory test-retest reliability (correlation = 0.75, *df* = 81). Item-total correlations ranged from 0.30 to 0.71 (median = 0.60). See Appendix 3 (p. 260) for the BAI items.

Subjective Unit of Distress Scale (SUDS). SUDS provides a quick and straightforward subjective measure of mood states. At each interview in this study, participants were asked "How upset have you been in the last week?". They were asked to rate the intensity of their emotion on a 0-100 visual analogue scale. Caution was taken to present the SUDS question separately from the discussion of the delusion, so that it tapped into general subjective distress rather than delusional distress. See Appendix 3 (p. 278) for the SUDS item.

3.3.3 Procedures

Table 3.1.

Timetable of assessment

Variables	Measures	Week 0	Week 1	Week 2	Week 4	Week 8
Symptom ratings	PANSS	*		*	*	*
	CGI	*		*	*	*
Dimensions of delusions	PSYRATS	*	*	*	*	*
	PQ	*	*	*	*	*
	VAS	*	*	*	*	*
Reasoning	MADS	*			*	*
	CBQ-P	*			*	*
	Beads task	*				*
	Cards task	*				*
Emotion	BDI	*			*	*
	BAI	*			*	*
	SUDS	*	*	*	*	*

Consenting participants were interviewed by the same researcher five times over a period of eight weeks (week 0, week 1, week 2, week 4, and week 8). The

first interview took place as soon as patients were admitted to the hospital, and within one month of the start of antipsychotic treatment.

In order not to over-burden the patients, not all measures were included at all assessment time points (see Table 3.1). Delusional dimensions and subjective distress were assessed at all time points as they are central to the key hypotheses. Symptom ratings were included at week 0, week 2, week 4, and week 8 in order to capture the potentially rapid change in the first few weeks. Questionnaires on reasoning and emotions were completed at a four-week interval as they were expected to change less quickly, whereas experimental tasks were included in the first and last interviews only.

Most of the measures were incorporated into systematic clinical interviews, whereas questionnaires (BDI-II, BAI, and CBQ-P) were completed by the participants on their own with guidance from the interviewer if necessary. The interviews began with symptom ratings and ended with less distressing tasks such as the CBQ-P and Cards task. The interviews lasted from 30 minutes to 1.5 hours each; breaks were given when necessary. Flexibility was given to the duration and content of the interviews, depending on the mental state of the participants. £10 per interview hour was given to the participants as remuneration for their time.

3.4 Statistical analysis

Statistical analyses were conducted using SPSS 15.0 for Windows (SPSS, 2006). Due to the intensive nature of the study not all participants were able or willing to complete all assessment time points. Twenty nine participants (72.5%) attended all five interviews, four (10.0%) attended four interviews, five (12.5%) attended three interviews and two (5.0%) attended one interview. There were no differences ($p > .05$) in age, baseline symptom scores, or reasoning variables between the completers and those who had missing data. Missing values were dealt with in different ways for different hypotheses in this study (see below).

For hypothesis 1 (modelling the effect of time, delusional dimensions and their interaction) and hypothesis 2 (examining changes of emotion measures), a mixed model for repeated measures (Twisk, 2006) was used. For each research question a series of models were tested and their model fit indices were compared.

The model with the lowest Akaike's Information Criterion (AIC) and Schwarz's Bayesian Criterion (BIC) was chosen as the best model. The mixed model approach was used because: (a) it includes fixed and random effects of modelling; (b) it models the effect of time as a continuous predictor, which is of importance as participants were assessed at irregular intervals; (c) it can handle unbalanced datasets (e.g. when missing values appear in some but not all dimensions within each individual); and (d) it allows a flexible way to model the correlation of errors. The mixed model method makes use of all the data available in the whole sample (N = 40). In the current dataset, residuals for all delusional dimensions and time points are normally distributed, hence mixed modelling is suitable.

For examining changes in repeated measures of dichotomous variables (i.e. JTC and BF), the McNemar and Cochran Q tests are recommended for analysing changes between two and more than two time points respectively (Bryman & Cramer, 2005). Only individuals with complete data at all time points for the particular variable were included in the analysis. Since missing values occurred in different variables at different time points, the sample size for each analysis, table and figure are stated clearly.

Three measures of delusional dimensions were included in this study – PSYRATS, PQ and VAS. Since results on changes in delusional dimensions were consistent across measures, the analyses reported in the results section pertain to one measure only for the sake of succinctness. VAS was chosen as it is more sensitive to the idiosyncratic nature of individuals' delusions, provides a continuous measure, and has the greatest range of ratings. Similar analyses were conducted for the other two measures, and are reported in Appendix 4.

Regression analyses were used to investigate the relationship between baseline reasoning biases and change in conviction.

3.5 Results

A total of 81 patients who presented with current delusions and had taken antipsychotics for less than a month were approached, but 41 declined to participate in the study. Therefore, a total of 40 consented participants were included in this study.

3.5.1 Demographic and clinical data

Sixty-two percent (n = 25) of the sample was female and the mean age was 32.2 years (range 18 to 62). The sample was drawn from the following ethnic groups: White British (12.5%), White Irish (7.5%), White other (2.5%), Black African (25%), Black Caribbean (17.5%), Black other (2.5%), Mixed (22.5%), Asian (5%), Chinese (2.5%) and Other (2.5%). The major psychiatric diagnoses were Schizophrenia (25.0%), Bipolar affective disorder (20.0%), Psychosis (17.5%), Schizoaffective disorder (10.0%), Acute and transient psychotic disorder (10.0%), Depression with psychotic features (10.0%), Delusional disorder (5.0%) and Schizophreniform disorder (2.5%). They had an average of 2.4 admissions for psychosis (*SD* = 2.73, range 1-15). Twenty six patients (65%) were admitted for their first episode of psychosis.

Eight participants (20.5%) had not started antipsychotic treatment when they were interviewed, and 27 participants (69.2%) had received antipsychotic treatment for less than 14 days. On average, patients were assessed 5.90 days (range 0-27) after the beginning of their antipsychotic treatment. The majority of the participants (92.3%) were on atypical antipsychotics (Olanzapine, Risperidone, Aripiprazole, Amisulpiride, and Quetiapine); one (2.56%) was on a typical antipsychotic (Trifluoperazine) and two (5.13%) were on both typical and atypical antipsychotics. The mean starting dose of antipsychotics in chlorpromazine equivalents (Andreasen *et al.*, 2010) was 195.6mg/day (SD = 119.1).

Although PANSS (Kay *et al.*, 1987) and CGI (Guy, 1976) were both measured, only the PANSS data will be reported here due to a high percentage of missing values in the CGI: 37.5% (week 0), 57.5% (week 2), 70% (week 4), 77.5% (week 8).

Table 3.2

Mean (SD) PANSS total and positive scores at different time points

	PANSS total score	PANSS positive score
Week 0 (*n*= 40)	69.30 (17.78)	21.75 (5.40)
Week 2 (*n*= 38)	54.32 (15.09)	16.08 (4.81)
Week 4 (*n*= 31)	54.29 (15.96)	15.71 (5.31)
Week 8 (*n*= 33)	51.70 (20.19)	13.45 (4.57)

The PANSS scores (Kay *et al.*, 1987) are shown in Table 3.2. According to Leucht *et al.* (2005b), the mean PANSS total score at baseline (69.30) would be considered as "mildly ill" to "moderately ill", while the mean PANSS total score at week 8 (51.70) would be considered as "borderline mentally ill" to "mildly ill".

Most individuals showed a decline in the PANSS scores over eight weeks. However, among the 33 individuals who completed PANSS at both week 0 and week 8, only five (15.2%) showed a >50% reduction in the PANSS total score, and 11 (33.3%) showed a 25-50% reduction, – i.e. a total of 16 (48.5%) showed a reduction of at least 25%, while ten (30.3%) reduced by 5-24%, four (12.1%) had a decrease or increase of <5%, two (6.1%) increased in the PANSS total score by 5-24%, and one (3.0%) increased by ≥25%. According to Leucht *et al.* (2005b), the average change in the PANSS total score (n = 33, mean = -17.27, *SD* = 19.05) over eight weeks would be considered as less than "minimally improved". For the PANSS positive score, eight individuals (24.2%) showed a >50% reduction over eight weeks, 14 (42.4%) showed a 25-50% reduction, eight (24.2%) reduced by 5-24%, two (6.1%) had a decrease or increase of <5%, none increased by 5-24%, and one (3.0%) increased by ≥25%.

Paired-sample t-tests were used to compare change in the PANSS scores in the first two weeks and that in the next two weeks. The percentage change of the PANSS positive score in the first two weeks (mean = -6.25%, *SD* = 8.78%) was significantly greater than the percentage change of the PANSS positive score in the next two weeks (mean = -1.55%, *SD* = 7.51%) (t = -2.00, df = 30, p = .05). The difference between percentage change in the PANSS total score in the first two weeks (mean = -14.54%, *SD* = 24.18%) and that in the second two weeks (mean = -2.22%, *SD* = 23.13%) did not reach statistical significance (t = -1.66, df = 30, p = .11).

3.5.2 Hypothesis 1: Delusional distress, preoccupation and impact on functioning will reduce before delusional conviction

3.5.2.1 Delusional dimensions at each time point

Mean scores of delusional dimensions on VAS at different time points are shown in Figure 3.1. Pearson correlations of the four dimensions at each time point are shown in Table 3.3.

As shown in Table 3.3, delusional dimensions at each time point were correlated with each other, and especially strongly at the later time points. At week 0, all dimensions were correlated ($p < .05$) except for Preoccupation and Disruption. At week 1, all dimensions were correlated ($p < .05$) except for Conviction and Distress. From week 2 onwards, all dimensions were significantly correlated with each other ($p < .01$).

Figure 3.1

Changes in VAS delusional dimensions (N = 40)

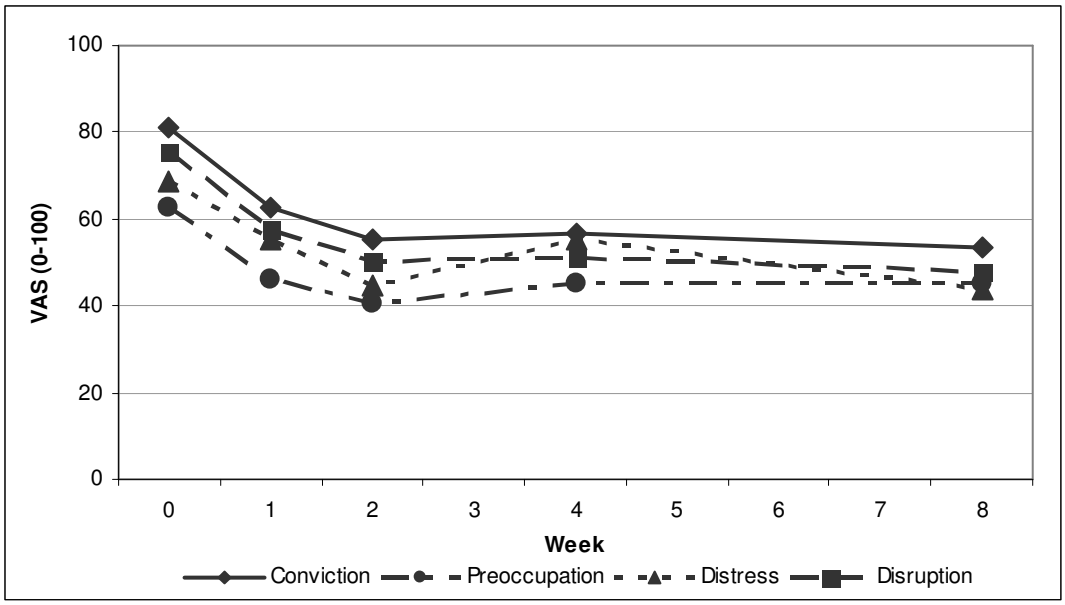


Table 3.3

Pearson correlations of delusional dimensions at each time point

		Week 0 (n = 36)			
		Conviction	Preoccupation	Distress	Disruption
Week 0	Conviction	1			
	Preoccupation	0.34 *p*=.05	1		
	Distress	0.44 *p*=.01	0.58 *p*<.01	1	
	Disruption	0.35 *p*=.04	0.28 *p*=.10	0.29 *p*=.02	1
		Week 1 (n = 34)			
		Conviction	Preoccupation	Distress	Disruption
Week 1	Conviction	1			
	Preoccupation	0.34 *p*=.05	1		
	Distress	0.30 *p*=.08	0.70 *p*<.01	1	
	Disruption	0.40 *p*=.02	0.51 *p*<.01	0.49 *p*<.01	1
		Week 2 (n = 35)			
		Conviction	Preoccupation	Distress	Disruption
Week 2	Conviction	1			
	Preoccupation	0.59 *p*<.01	1		
	Distress	0.46 *p*<.01	0.79 *p*<.01	1	
	Disruption	0.66 *p*<.01	0.59 *p*<.01	0.60 *p*<.01	1
		Week 4 (n = 29)			
		Conviction	Preoccupation	Distress	Disruption
Week 4	Conviction	1			
	Preoccupation	0.73	1		

		p<.01			
	Distress	0.74	0.84	1	
		p<.01	*p*<.01		
	Disruption	0.62	0.72	0.79	1
		p<.01	*p*<.01	*p*<.01	
		Week 8 (n = 32)			
		Conviction	Preoccupation	Distress	Disruption
Week 8	Conviction	1			
	Preoccupation	0.81	1		
		p<.01			
	Distress	0.67	0.87	1	
		p<.01	*p*<.01		
	Disruption	0.69	0.77	0.72	1
		p<.01	*p*<.01	*p*<.01	

3.5.2.2 Changes in delusional dimensions

Using the maximum likelihood method, the effects of Time and Dimension, and the Time x Dimension interaction on the VAS scores were tested in a linear mixed model (AIC = 6323.38, BIC = 6417.75). There was a significant effect of Time (F = 9.22, df = 1, p < .01) and Dimension (F = 8.87, df = 3. p < .01). However, the Time x Dimension interaction effect was not significant (F = 1.08, df = 3, p = .36). Therefore, the interaction effect was removed and a second model with the effects of Time and Dimension on the VAS scores was tested. The model fit indices of the second model (AIC = 6320.60, BIC = 6401.48) indicated a better fit of the data. Again, the effects of Time (F = 9.01, df = 1, p < .01) and Dimension (F = 10.57, df = 3, p < .01) were both significant. In order to check whether the effect of Time is non-linear, a third model with the effects of Dimension, Time, and a quadratic term of time (squared Time) was tested. The model fit indices of the third model (AIC = 6313.10, BIC = 6398.48) indicated a better fit of the data than the previous two models. In this model, the effects of Time (F = 15.79, df = 1, p < .01), Squared Time (F = 10.00, df = 1, p < .01), and Dimension (F = 10.55, df = 3, p < .01) were all significant. In other words, all dimensions declined over time, and the reduction became smaller over time. There was a significant difference between dimensions but there was no interaction between dimensions and time.

Therefore, the hypothesis that delusional conviction reduces more slowly or to a lesser degree than the other dimensions, was not supported.

Pair-wise comparisons between dimensions were tested based on estimated marginal means in the same model (i.e. the third model). With Bonferroni adjustment for multiple comparisons, level of Conviction was significantly higher than Preoccupation (difference = 13.715, *SE* = 2.534, *df* = 164.978, $p < .01$) and Distress (difference = 8.04, *SE* = 2.78, *df* = 166.01, $p = .03$), and was comparable with Disruption (difference = 4.81, *SE* = 2.62, *df* = 166.08, $p = .40$).

3.5.2.3 Does early change in delusional dimensions predict subsequent change?

Linear regression was performed to test whether change in delusional dimensions in the first two weeks predicts change in delusional dimensions over eight weeks, using all available data in the whole sample (N = 40). Percentage change in the first two weeks predicted percentage change over eight weeks for Conviction (*B* = 0.81, *SE* = 0.17, $p < .01$) and Preoccupation (*B* = 0.14, *SE* = 0.03, $p < .01$), but not Distress ($p = .36$) or Disruption ($p = .44$). Percentage change in the first week predicted percentage change over eight weeks in three delusional dimensions: Preoccupation (*B* = 0.47, *SE* = 0.20, $p = .03$), Distress (*B* = 0.47, *SE* = 0.15, $p < .01$), Disruption (*B* = 0.40, *SE* = 0.11, $p < .01$).

Linear regression was also performed to test whether the percentage change in the PANSS scores in the first two weeks predicted the percentage change in the PANSS scores over eight weeks. Using all available data in the whole sample (N = 40), the percentage change in the PANSS total score in the first two weeks predicted the percentage change in the PANSS total score over eight weeks (*B* = 0.52, *SE* = 0.14, $p < .01$). Similarly, the percentage change in the PANSS positive score in the first two weeks predicted the percentage change in the PANSS positive score over eight weeks (*B* = 0.63, *SE* = 0.14, $p < .01$).

3.5.3 Hypothesis 2: Depression, anxiety and subjective distress will reduce alongside improvements in delusional dimensions

Mean scores on BDI-II, BAI, and SUDS at different time points are shown in Table 3.4 and Figures 3.2 and 3.3.

Table 3.4

Mean levels (SD) of depression, anxiety and subjective distress

	Week 0	Week 1	Week 2	Week 4	Week 8
BDI-II	*n*=39			*n*=28	*n*=29
	20.38			19.14	17.14
	(15.22)			(13.81)	(13.61)
BAI	*n*=39			*n*=28	*n*=29
	21.59			16.79	14.24
	(15.11)			(12.98)	(12.98)
SUDS	*n*=39	*n*=36	*n*=36	*n*=30	*n*=32
	54.72	43.83	50.64	59.13	40.66
	(35.86)	(34.16)	(32.25)	(34.99)	(36.94)

According to Beck *et al.* (1996), the average BDI-II scores indicated moderate depression (20-28) at baseline, and mild depression (14-19) at week 8, although the mean score change was modest. The average BAI scores fell within the levels of moderate anxiety (16-25) at baseline, and mild anxiety (8-15) at week 8 (Beck *et al.*, 1988).

Figure 3.2

Changes in BDI-II and BAI scores (N = 40)

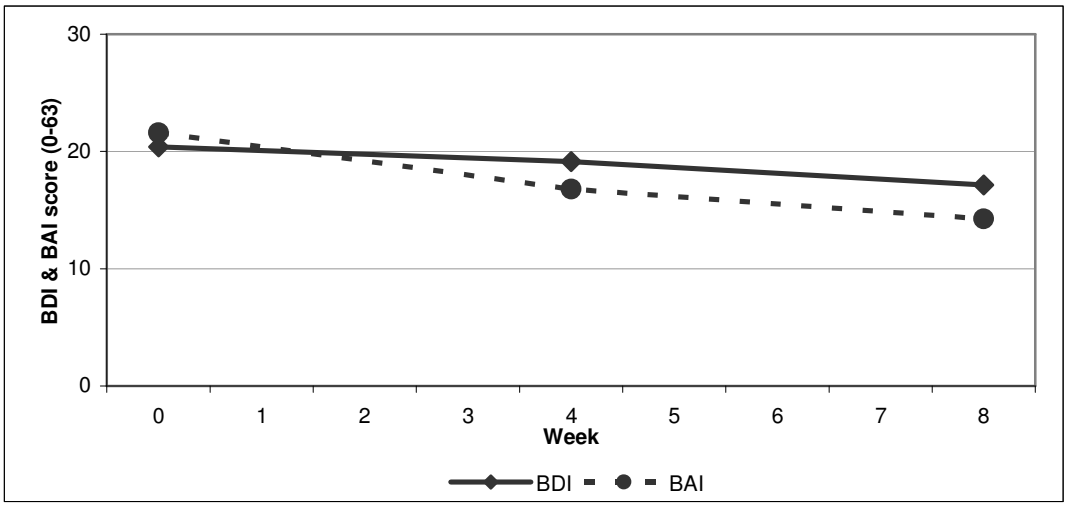
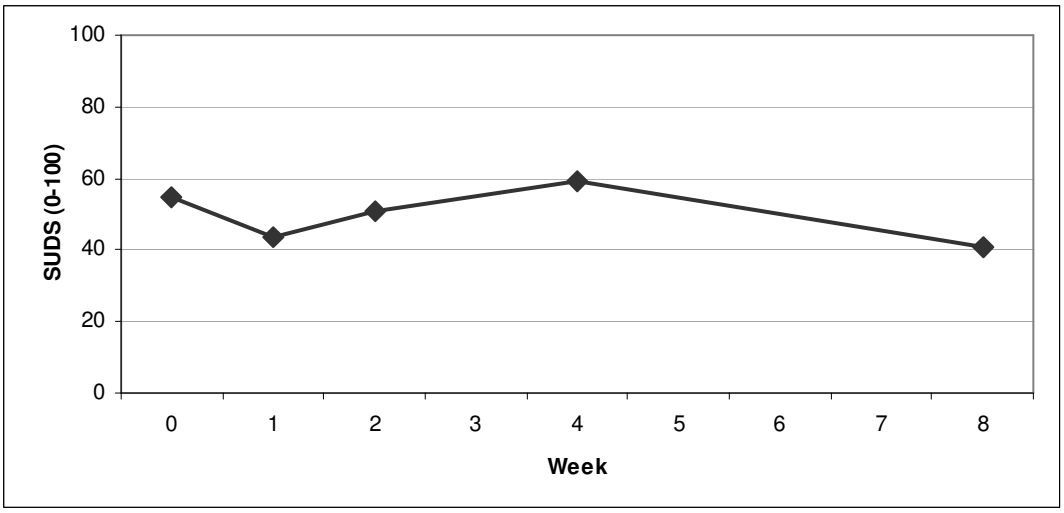


Figure 3.3

Change in SUDS (N = 40)



3.5.3.1 Change in depression, anxiety and subjective distress

Changes in mood were analysed using both Analysis of Variance (ANOVA) and mixed modelling approaches. This is because ANOVA was used in previous studies reporting change in mood during antipsychotic treatment (e.g. Nakaya *et al.*, 1997) and using the same statistical approach allows comparison with other studies. Additionally, mixed models use all cases even in the presence of missing data and is a method consistently used in this study for other hypotheses involving continuous data measured repeatedly.

In individuals with complete data on BDI-II (n = 26), a repeated-measures ANOVA revealed a trend only in score difference across the three time points (F = 2.79, df = 2, p = .07). On BAI (n = 26), there was a significant difference across the three time points (F = 5.70, df = 2, p = .01). Paired-sample t-tests found a significant reduction in BAI between week 0 and week 4 (t = 2.37, df = 25, p = .03), and no significant change between week 4 and week 8 (t = 1.18, df = 25, p = .25). In individuals with complete data on SUDS (n = 27), repeated-measures ANOVA revealed a significant difference across the five time points (F = 2.99, df = 4, p = .02). Paired-sample t-tests showed a significant decrease in SUDS between week 4 and week 8 (t = 2.91, df = 26, p = .01), a trend reduction between week 0 and week 1 (t = 1.89, df = 26, p = .07), and no significant change between week 1 and week 2 (t = -1.58, df = 26, p = .13) and between week 2 and week 4 (t = -0.54, df = 26, p = .13).

Three mixed models examining the effect of Time on the BDI-II, BAI and SUDS ratings respectively were tested, using the maximum likelihood (ML) estimation. In the model with the BDI-II scores as the dependent variable (DV) and Time as a fixed independent variable (IV) (AIC = 788.74, BIC = 798.99), the effect of Time was not significant (F = 0.44, df = 2, p = .65). In the model with the BAI scores as the DV and Time as a fixed IV (AIC = 782.57, BIC = 792.82), the effect of Time was at trend level only (F = 2.55, df = 2, p = .08). In the model with SUDS as the DV and Time as a fixed IV (AIC = 1726.43, BIC = 1745.35), the effect of Time was not significant (F = 1.60, df = 4, p = .18).

In summary, ANOVAs revealed significant improvements in anxiety and subjective distress over time, and a trend for depression, using data from participants with complete data. However, when a mixed modelling approach was used, including all available data, a trend effect of time was found for anxiety, and no effect for subjective distress or depression.

3.5.3.2 Relationship between change in depression and change in delusional dimensions

The relationship between change in BDI-II and change in delusional dimensions over time was tested using linear mixed modelling, with the maximum likelihood (ML) estimation. A series of models was tested and the model with the lowest Akaike's Information Criterion (AIC) and Schwarz's Bayesian Criterion

(BIC) was chosen as the best model. The first model tested the effect of Time on BDI-II, with four delusional dimensions included as fixed covariates (AIC = 727.76, BIC = 747.66). In this model, the effect of Time was not significant ($F = 0.34$, $df = 2$, $p = .71$). The effect of delusional preoccupation ($F = 4.61$, $df = 1$, $p = .03$) as a covariate was significant, whereas that of other dimensions were not ($p > .05$). Since the delusional dimensions were strongly correlated (see Table 3.3), four more models were tested with BDI-II as the DV, Time as the IV, and each dimension as a covariate. The model fit indices of these four models are as follows: model with Conviction as a covariate (AIC = 749.27, BIC = 761.83); model with Preoccupation as a covariate (AIC = 725.45, BIC = 737.90); model with Distress as a covariate (AIC = 735.84, BIC = 748.34), and model with Disruption as a covariate (AIC = 744.96, BIC = 757.52). Therefore, the model with Preoccupation as a covariate in predicting the effect of time on BDI-II was the best model. In this model, Time was not a significant predictor of BDI-II ($F = 0.35$, df = 2, $p = .71$) and Preoccupation was a significant covariate ($F = 9.96$, df = 1, $p < .01$) in the relationship between BDI-II and time. An additional model with both Preoccupation and Preoccupation x Time interaction as covariates was also tested, but it showed a poorer fit of the data (AIC = 727.68, BIC = 745.10) than the model without the interaction term. In summary, delusional preoccupation covaried with depression; its effect as a covariate did not change over time.

3.5.3.3 Relationship between change in anxiety and change in delusional dimensions

The relationship between change in BAI and change in delusional dimensions over time was tested using linear mixed modelling, with the ML estimation. A series of models was tested and the model with the lowest AIC and BIC was chosen as the best model. The first model tested the effect of Time on BAI, with four delusional dimensions included as fixed covariates (AIC = 707.83, BIC = 727.74). In this model, the effect of Time was not significant ($F = 2.11$, $df = 2$, $p = .13$). The effects of Conviction ($F = 4.25$, df = 1, $p = .04$) and Preoccupation ($F = 6.46$, $df = 1$, $p = .01$) as covariates were significant. Distress and Disruption were not significant covariates ($p > .05$). Since the delusional dimensions were strongly correlated (see Table 3.3), four more models were tested with BAI as a DV, Time as an IV, and each dimension as a covariate. The model fit indices of these

four models are as follows: model with Conviction as a covariate (AIC = 739.77, BIC = 752.33); model with Preoccupation as a covariate (AIC = 707.97, BIC = 720.41); model with Distress as a covariate (AIC = 717.21, BIC = 729.71), and model with Disruption as a covariate (AIC = 736.36, BIC = 748.91). Therefore, the model with Preoccupation as a covariate in predicting the effect of time on BAI was the best model. In this model, Time was not a significant predictor of BAI (F = 1.80, df = 2, p = .17), and Preoccupation was a significant covariate (F = 18.71, df = 1, p < .01) in the relationship between BAI and time. An additional model with both Preoccupation and Preoccupation x Time interaction as covariates was also tested, but it showed a poorer fit of the data (AIC = 711.70, BIC = 729.12) than the model without the interaction term. While the model with BAI as the DV, Time as the IV, and Preoccupation as a covariate was the best model, the model with four dimensions as covariates should also be discussed as its AIC almost equalled the best model and its BIC was only seven units greater than the best model. In summary, delusional preoccupation (and conviction) covaried with anxiety; their effects as covariates did not change over time.

3.5.3.4 Relationship between change in subjective distress and change in delusional dimensions

The relationship between change in SUDS and change in delusional dimensions over time was tested using linear mixed modelling, with the ML estimation. A series of models were tested and the model with the lowest AIC and BIC was chosen as the best model. The first model tested the effect of Time on SUDS, with four delusional dimensions included as fixed covariates (AIC = 1543.50, BIC = 1574.44). In this model, the effect of Time was not significant (F = 2.22, df = 4, p = .07). The effects of Conviction (F = 4.76, df = 1, p = .03), Distress (F = 15.01, df = 1, p < .01), and Disruption (F = 16.11, df = 1, p < .01) as covariates were significant, whereas that of Preoccupation was not significant (F = 2.26, df = 1, p = .14). Four more models were tested with SUDS as the DV, Time as the IV, and each dimension as a covariate. The model fit indices of these four models are as follows: model with Conviction as a covariate (AIC = 1643.03, BIC = 1664.82); model with Preoccupation as a covariate (AIC = 1574.72, BIC = 1596.38); model with Distress as a covariate (AIC = 1565.43, BIC = 1587.13), and model with Disruption as a covariate (AIC = 1591.80, BIC = 1613.54). Therefore, the model

with all four dimensions as covariates in predicting the effect of time on SUDS was the best model. An additional model with delusional dimensions and dimension x Time interaction as covariates was also tested, but it showed a poorer fit of the data (AIC = 1555.66, BIC = 1636.10) than the model without the interaction terms, and none of the interaction terms was significant ($p > .05$). In summary, delusional conviction, distress and disruption, but not preoccupation, covaried with subjective distress, and their effects as covariates did not change over time.

3.5.4 Hypothesis 3: Belief flexibility (but not JTC) will improve

3.5.4.1 JTC

Table 3.5

Beads task performance of individuals with complete data (n = 27)

No. of beads drawn	Week 0	Week 8
1	19	18
2	2	2
3	1	3
4	0	0
5	1	0
6	1	1
8	1	1
12	1	0
15	1	0
20	0	2

Note: Individuals who requested 2 beads or fewer were classified as showing the JTC bias (Garety *et al.*, 2005)

Table 3.5 shows the beads task performance of the 27 participants who completed the task at both week 0 and week 8. At baseline, 21 individuals (77.77%) showed a JTC bias (requesting two beads or fewer), whereas 20 (74.07%) jumped to conclusions at week 8. Among the 27 completers, 70.4% and 63.0% gave the correct answer at baseline and week 8 respectively. The mean number of beads

drawn was 2.67 (SD = 3.61) and 3.15 (SD = 5.13) at baseline and week 8 respectively.

Table 3.6

Cross-tabulation comparison of beads task performance among individuals with complete data (n = 27)

		Week 8 JTC		
		No	Yes	Total
Week 0 JTC	No	3	3	6
	Yes	4	17	21
Total		7	20	27

Table 3.6 shows the within-subject changes of beads task performance across time points. The McNemar test, a non-parametric test for categorical variables in two related samples, showed no significant difference in JTC at week 0 and week 8 (p = 1.00). A paired-sample t-test also found no change in the number of draws to decision (t = -0.55, df = 26, p = .59).

3.5.4.2 Belief flexibility

Possibility of being mistaken (PM). Among the 30 participants who had complete data on the PM measure, nine (30.0%), 16 (53.3%), and 18 (60.0%) considered that they might be mistaken about their delusional belief at baseline, week 4 and week 8 respectively.

Table 3.7

Cross-tabulation comparison (week 0 vs. week 4 & week 8) of PM among participants with complete data (n = 30)

		Week 4 PM			Week 8 PM		
		-ve	+ve	Total	-ve	+ve	Total
Week 0 PM	-ve	10	11	21	8	13	21
	+ve	4	5	9	4	5	9
Total		14	16	30	12	18	30

Table 3.8

Cross-tabulation comparison (week 4 vs. week 8) of PM among participants with complete data (n = 30)

		Week 8 PM		
		-ve	+ve	Total
Week 4 PM	-ve	11	3	14
	+ve	1	15	16
Total		12	18	30

Tables 3.7 and 3.8 show the within-subject changes of PM across time points. The Cochran Q test, a non-parametric test for categorical variables in more than two related samples, showed a significant difference (p = .02) in PM across time points. Pair-wise comparisons using the McNemar test found a significant difference in PM between week 0 and week 8 (p = .05), but not between week 0 and week 4 (p = .12), or between week 4 and week 8 (p = .63).

Reaction to hypothetical contradiction (RTHC). Among the 29 participants who had complete data on the RTHC measure, 12 (41.4%), 15 (51.7%), and 16 (55.2%) gave a positive response (i.e. showed flexibility) to a hypothetically contradictory evidence at baseline, week 4 and week 8 respectively. Tables 3.9 and 3.10 show the within-subject changes of RTHC across time points. The Cochran Q test showed no significant difference (p = .44) in RTHC across time points.

Table 3.9

Cross-tabulation comparison (week 0 vs. week 4 & week 8) of RTHC among participants with complete data (n = 29)

		Week 4 RTHC			Week 8 RTHC		
		-ve	+ve	Total	-ve	+ve	Total
Week 0	-ve	9	8	17	8	9	17
RTHC	+ve	5	7	12	5	7	12
Total		14	15	29	13	16	29

Table 3.10

Cross-tabulation comparison (week 4 vs. week 8) of RTHC among participants with complete data (n = 29)

		Week 8 RTHC		
		-ve	+ve	Total
Week 4	-ve	11	3	14
RTHC	+ve	2	13	15
Total		13	16	29

3.5.4.3. Cognitive Biases Questionnaire for Psychosis (CBQ-P)

Fifteen individuals had complete data on CBQ-P across three time points. The mean total scores were 51.60 (*SD* = 13.45), 49.27 (*SD* = 10.46), and 43.40 (*SD* = 10.38) at baseline, week 4, and week 8 respectively. Repeated-measures ANOVA showed a significant difference ($F = 4.00$, $df = 2$, $p = .03$) in the CBQ-P score across time points. Paired-sample t-test showed a significant difference in CBQ-P between week 4 and week 8 ($t = 2.76$, $df = 14$, $p = .02$), and a difference at trend level between week 0 and week 8 ($p = .06$), but not between week 0 and week 4 ($p = .39$).

3.5.4.4. Cards task

Twenty seven individuals had complete data on the cards task at both baseline and week 8 (see Table 3.11 for mean scores and SDs). Paired-sample t-tests showed significant improvement in items 1 (i.e. mind permeability) ($t = 2.99$, $df = 26$, $p = .01$) and 2 (i.e. intentionality) ($t = 2.08$, $df = 26$, $p = .05$), but not the other four items, although the ratings were all on the decrease.

Table 3.11

Mean levels (SD) on Cards task items in participants with complete data (n = 27)

	Week 0	Week 8
1: "It works because the system is able to read people's mind"	38.26 (39.43)	19.44 (31.20)
2: "It is not the computer that guessed; there is someone involved behind this"	44.07 (38.92)	27.15 (31.67)
3: "It is a trick that is part of a bigger conspiracy against me"	33.19 (35.31)	23.04 (37.07)
4: "It was done to trick me or make me look stupid"	32.78 (36.74)	20.85 (33.32)
5: "It is just a puzzle"	51.37 (39.58)	63.11 (33.23)
6: "It is related to some of my recent experiences"	45.70 (41.64)	32.93 (37.46)

Note: Scores range from 0 (Do not believe this at all) to 100 (Totally believe this)

3.5.5 Hypothesis 4: Baseline reasoning biases will moderate changes in conviction

3.5.5.1 Do individuals with and without reasoning biases differ in delusional conviction at baseline?

Independent *t*-tests showed no significant difference (t = 0.91, df = 33, p = .37) in baseline conviction (as measured by VAS) between individuals with the JTC bias (n = 27, mean = 83.07, *SD* = 26.26) and those without the JTC bias (n = 8, mean = 73.13, *SD* = 30.35). However, individuals who responded positively to the Possibility of being mistaken (PM) item at baseline (n = 11, mean = 55.09, *SD* = 31.29) had significantly lower conviction at baseline (t = -5.07, df = 34, $p < .01$) than those who responded negatively to the item (n = 25, mean = 92.88, *SD* = 13.94). Similarly, individuals who responded positively to the Reaction to

hypothetical contradiction (RTHC) at baseline (n = 12, mean = 63.00, *SD* = 33.67) had significantly lower conviction at baseline (t = -3.27, df = 34, $p < .01$) than those who responded negatively to the item (n = 24, mean = 90.50, *SD* = 17.23). There was no significant correlation between VAS conviction and CBQ-P score at baseline (n = 24, r = 0.20, p = .34).

3.5.5.2 Do baseline reasoning biases predict change in conviction, after controlling for baseline conviction?

Linear regression was performed (N = 40) with the baseline reasoning measures as the IV, change in VAS conviction between week 0 and week 8 as the DV, and baseline VAS conviction as a covariate. After controlling for baseline conviction, none of the reasoning measures at baseline predicted change in conviction: JTC (β = -0.16, *SE* = 17.07, p = .36), PM (β = 0.14, *SE* = 20.60, p = .52), RTHC (β = -0.06, *SE* = 17.93, p = .75), CBQ-P (β = 0.10, *SE* = 0.73, p = .63). This result remained the same when PSYRATS and PQ were used to measure delusional conviction.

3.6 Discussion

This is the first study, to our knowledge, investigating changes in delusional dimensions, reasoning and affect in response to antipsychotic treatment. Forty patients with a high level of delusional conviction (mean >80%) were assessed five times over eight weeks, as soon as they began antipsychotic treatment for their current psychotic episode. Sixty five percent of this sample had a first episode of psychosis. The key findings are as follows. Delusional dimensions were correlated with each other at each time point, and improved together over time. While the level of delusional conviction was higher than other dimensions, the hypothesis that conviction reduces more slowly or to a lesser degree was not supported. Depression did not improve over eight weeks of antipsychotic treatment, whereas there was modest evidence that anxiety and subjective distress improved (although this improvement was not significant on an analysis of all available data using mixed modelling). Depression and anxiety co-varied with delusional preoccupation over time, whereas subjective distress co-varied with conviction, distress and disruption. The hypothesis that belief flexibility (but not JTC) would improve was partially

supported. JTC did not improve over eight weeks, while one of the measures for belief flexibility – Possibility of being mistaken (but not Reaction to Hypothetical Contradiction) – as well as the Cognitive Biases Questionnaire score, improved. The hypothesis that baseline reasoning biases would moderate changes in conviction was not supported.

Our finding that delusional conviction did not change more slowly or to a lesser degree than other delusional dimensions is not consistent with Mizrahi *et al.* (2006), which suggested that antipsychotics rapidly reduce the behavioural impact, preoccupation, and distress relating to the principal psychotic symptom, without greatly altering the patients' conviction in, or perspective about their psychotic experience in the early weeks of treatment. While Mizrahi *et al.* (2006) found that conviction reduced for 6.4% at two weeks and 24.9% at six weeks, we found a notable improvement in conviction early on (26.1% over 2 weeks and 25.5% over eight weeks). It is of note, however, that the level of conviction was higher than other dimensions across time points, and the mean level of conviction remained over 50% at week 8. The difference in findings may be attributed to the fact that this study assessed delusions only, while Mizrahi *et al.* (2006) assessed the 'principal psychotic experience'. More importantly, the Dimensions of Psychosis Instrument (DIPI) used by Mizrahi *et al.* (2006) includes two questions on conviction, one of which is as follows: "Do you sometimes think X is true but then think it is part of an illness?" While the other question ("How sure are you about X, any doubts about it? Are you certain it is true?") is similar to our assessment of conviction, the former is more related to insight than to conviction. Although these two items loaded onto one factor in Mizrahi *et al.* (2006)'s confirmatory factor analysis, it is not clear whether responses to these items changed differentially. It remains a possibility that patients reduced in conviction but still did not recognise their belief as part of a psychiatric illness. Using measures purely focusing on delusional conviction (without referring to insight or reflection on the belief), we found that conviction changed similarly to other dimensions, and this finding was consistent across three multi-dimensional measures.

There was a quadratic relationship of time in the change in delusional dimensions, i.e., reductions in the dimensions became smaller over time. There was also a greater reduction in the PANSS positive score in the first two weeks

compared to the next two weeks. Early improvements in the first two weeks predicted the overall changes over eight weeks for two delusional dimensions and the PANSS scores. These findings support the 'early onset' hypothesis suggested by Agid *et al.* (2003), which argues that antipsychotic effect begins to take place in the first week (even days) of treatment. While a large number of studies showed evidence for the 'early onset' hypothesis using PANSS scores, the present study is the first to reveal the 'early onset' of antipsychotic effects on delusional dimensions. However, one should be mindful of the fact that our sample was not drug-free and had begun antipsychotic treatment for a few days on average. Based on the finding that treatment effects took place early on, Study 3 of this thesis aims to further investigate changes in delusional dimensions within a shorter timeframe (i.e. moment-by-moment changes in 14 days of the start of antipsychotic treatment).

The current sample consisted of individuals with strong delusional conviction and a strong tendency to JTC across time points. Approximately 77% and 74% showed a JTC style (defined as two or fewer beads) at baseline and week 8 respectively. Seventy percent (n = 19 and 18 at baseline and week 8 respectively) decided after only one bead. These rates are higher than previous studies using the beads task (see Chapter 2), including studies using the easier 85:15 ratio version, and also including Menon *et al.* (2008), which measured deluded patients at their early stage of antipsychotic treatment. It is possible that, despite repeating the instructions, some of the participants did not understand the beads task thoroughly enough for the assessment to be reliable. For example, one patient commented that "Normally it is orange, but I'll choose black", and another patient said that "How do I know? It's got to be the second one". Two other patients refused to do the task because they did not think the task was relevant to their current experience. Nevertheless, since we did not formally assess participants' understanding of the task, the reason behind the unusually high rate of JTC in this sample remains a speculation.

The proportion of individuals showing belief flexibility at baseline on RTHC (41%) is comparable with previous studies, although that on PM (30%) is relatively low. We found that JTC was not associated with level of conviction at baseline, and did not predict change in conviction. These results confirm that JTC is highly prevalent in deluded patients, but suggest that it is not closely associated

with the delusional state and do not directly support the role of JTC in the maintenance of delusions as proposed in Garety *et al.*'s (2005) model. However, the fact that JTC was very common in this sample may have limited the power of this study to examine the relationship between JTC and conviction. Therefore, our finding needs to be replicated in a larger sample with a wider range of JTC and conviction level before any firm conclusions can be made. As hypothesised in this study, and as reported in previous studies (e.g. Peters & Garety, 2006), JTC did not change after eight weeks of antipsychotic treatment. The only study that reported a change in JTC within weeks was Menon *et al.* (2008), where the change was in the emotionally salient version of the beads task which was not used in the current study.

This is the first study showing evidence for a change in BF following antipsychotic treatment. In support of our hypothesis, individuals were more likely, at week 8 than at baseline, to see the possibility of being mistaken about their delusional belief. Cognitive biases (as measured by the Cognitive Biases Questionnaire for Psychosis) and some of the appraisals on the Cards task also changed over time, becoming less pathological. In contrast to the traditional view that delusions are persistent and unchanging, these findings suggest that cognitive biases underlying delusions, including BF, are capable of improving after only eight weeks in the early stage of antipsychotic treatment, despite JTC remaining prevalent. The mechanism of change of cognitive biases following antipsychotic treatment remains an open question. However, our data showed a strong association between BF and delusional conviction. The mean levels of conviction were 55% for individuals who recognised the possibility of being mistaken about their delusion and 92% for individuals who did not. Similarly, the mean levels of conviction were 63% for individuals who changed their belief in response to hypothetical contradiction and 90% for those who did not. This may explain why baseline BF did not predict change in conviction when baseline conviction was controlled for, since there was little room for improvement in the more flexible group. While a close relationship between conviction and BF is consistent with previous studies and Garety *et al.* (2005)'s model, this raises the question as to whether BF is simply another way of measuring conviction. Also, it would be of interest to further investigate whether the various measures of BF represent the same construct, given

the differences in changes in the two measures included in this study. Study 2 aims to examine these questions with multiple measures of reasoning biases and conviction, using a longitudinal factor analysis approach.

This sample had a moderate level of depression and a moderate-to-severe level of anxiety at baseline. Contrary to our hypothesis, subjective distress, depression and anxiety did not improve significantly over eight weeks. This is inconsistent with previous studies that reported a reduction of anxiety following antipsychotic treatment (see Chapter 1). However, when the current sample was analysed using repeated-measures ANOVA, which is a less robust method than mixed modelling approach but one that has been used in previous studies, anxiety and subjective distress improved over time. Intriguingly, delusional preoccupation co-varied with depression and anxiety, whereas other delusional dimensions (but not preoccupation) co-varied with subjective distress. These results suggest that subjective distress was more closely linked to participants' immediate symptomatic status than depression and anxiety. The finding that SUDS did not co-vary with preoccupation was not expected. However, given that all dimensions were strongly correlated across time points, and that three dimensions co-varied with subjective distress at a highly significant level, the non-significance of preoccupation as a covariate should not be over-interpreted.

The specific link between delusional preoccupation and anxiety and depression is intriguing. There is much evidence that repetitive thought processes (rumination in depression, and worry in anxiety), may maintain emotional disorders (see Watkins (2008) for a review). The present findings suggest that repetitive thoughts around delusions may also be linked to depression and anxiety. Such a relationship would be consistent with the rationale behind a recent intervention for delusions which focused specifically on reducing worry (Foster *et al.*, 2010).

A caveat of the current findings is that although delusional dimensions improved over time, the amount of change was not extensive and patients retained a high level of delusional conviction. Furthermore, there was only modest change in affect. Therefore, this study might not be the most suitable for investigating the temporal relationship between affect and delusions. This study is also limited by the fact that its main focus was on antipsychotics and did not include data about other medications such as anti-depressants and anxiolytics.

To conclude, this study demonstrated improvement in all delusional dimensions over eight weeks during an early phase of antipsychotic treatment, with most of the change occurring in the first two weeks, which was predictive of later change. This improvement occurred without a significant change in affect. Importantly, the psychological response to antipsychotic treatment included cognitive changes such as delusional conviction, belief flexibility and appraisals, but not the JTC reasoning style.

Chapter 4

Study 2: Jumping to conclusions, a lack of belief flexibility and delusional conviction in psychosis: A longitudinal investigation of the structure, frequency and relatedness of reasoning biases

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4.1 Introduction

The Diagnostic and Statistical Manual defines delusion as 'A false belief based on incorrect inference about external reality that is firmly sustained despite what almost everyone else believes and despite what constitutes incontrovertible and obvious proof or evidence to the contrary' (APA, 2000). Thus a delusional belief is incorrect; it is based on erroneous judgements about the world; and it is unresponsive to countervailing evidence. Biases of reasoning have been invoked to understand the process of delusion formation, and limited data-gathering ('jumping to conclusions'; JTC) and a failure to think of alternative accounts to the delusion (a lack of 'belief flexibility') have previously been shown to be related to how strongly a delusion is held (delusional conviction) (e.g. Freeman *et al.*, 2004; Garety *et al.*, 2005). In this study, the single largest study of its type, we wanted to: (a) examine the prevalence of the reasoning biases, JTC and lack of belief flexibility, in individuals with delusions; (b) evaluate the structure of delusional conviction, JTC, and belief flexibility and whether they are distinct processes; and (c) assess whether delusional conviction would vary in response to levels of JTC bias and belief flexibility.

4.1.1 Reasoning processes associated with delusions

The most replicated reasoning bias in delusion research is JTC, a tendency to gather less data than controls to reach a decision (reviewed by Fine *et al.*, 2007; Garety & Freeman, 1999; Freeman, 2007). Limited decision-making encourages the rapid acceptance of erroneous beliefs. Research published so far has involved relatively small numbers of participants, with JTC being apparent in between one third and two-thirds of individuals with delusions (e.g. Garety *et al.*, 1991, 2005; Moritz & Woodward, 2005; Startup, Freeman & Garety, 2008; Van Dael *et al.*, 2006). It has also been reported in people 'at risk' for psychosis (Broome *et al.*, 2007), and, to an attenuated degree, in the relatives of people with psychosis and in people scoring highly on delusional ideation scales (e.g. Colbert & Peters, 2002; Freeman *et al.*, 2008; Van Dael *et al.*, 2006; Warman & Martin, 2006). In cross-sectional studies, it is greatest in patients with current delusions (e.g. Lincoln *et al.*,

2010; Van Dael *et al.*, 2006). There have been few longitudinal investigations of JTC: in a systematic review (So *et al.*, 2010), three such studies are reported (Peters & Garety, 2006; Menon *et al.*, 2008; Woodward *et al.*, 2009). The available data show that JTC does not improve consistently over time or with symptom improvement, but there is some evidence that baseline JTC predicts outcome. For example, JTC was shown to moderate the response to anti-psychotic treatments in a drug naïve group of patients with a first episode of psychosis: those with an extreme JTC bias showed a poorer treatment response (Menon *et al.*, 2008). Taken as a whole, the evidence suggests that it is likely that JTC is a relatively stable trait increasing susceptibility to the development of delusions and which may predict change over time.

Belief flexibility (BF) in psychosis refers to 'a meta-cognitive process about thinking about one's own delusional beliefs, changing them in the light of reflection and evidence and generating and considering alternatives' (Garety *et al.*, 2005, p. 374). It has been assessed with the Possibility of Being Mistaken (PM) and Reaction to Hypothetical Contradiction (RTHC) items of the Maudsley Assessment of Delusions Schedule (MADS; Wessely *et al.*, 1993). These items assess, in the context of an interview about delusional beliefs, whether the individual can consider it 'at all possible' that they might be mistaken in their belief, however unlikely, and also to consider a hypothetical but plausible piece of evidence that might counteract their belief. We have since developed a further item which we also consider taps belief flexibility, in the Explanation of Experiences assessment (Freeman *et al.*, 2004). In this, persons with delusions are asked if they can think of any possible alternative explanation for the evidence they cite in support of their delusion, other than the delusional explanation (Alternative Explanations AE). Contrary to the traditional view of delusions as fixed and unresponsive to countervailing evidence, approximately one quarter to one half of individuals with delusions demonstrate BF on any one of these assessments (e.g. Buchanan *et al.*, 1993; Colbert *et al.*, 2010; Freeman *et al.*, 2004). For example, Garety *et al.* (2005) found that half of those with delusions acknowledged that there was a possibility that they were mistaken, while Freeman *et al.* (2004) reported that a quarter of individuals with delusions could generate alternative explanations for their experiences even if they did not agree with them. There have been no longitudinal studies of BF, as measured in

this way, although, in one study, we found evidence of improvement over time in evidence evaluation, suggesting that belief flexibility may change as delusions remit (So *et al.*, 2010). There is also some evidence that it might predict change. Flexibility, as assessed by the Possibility of Being Mistaken item, predicted successful response to psychological therapy for psychosis in a randomised controlled trial (Garety *et al.*, 1997). We therefore hypothesised that change in delusions may be facilitated by a willingness to consider that a delusion may be mistaken and that alternative explanations might be possible. It has further been argued that JTC influences delusional conviction via a lack of BF (Garety *et al.*, 2005). Limited data-gathering (JTC) may preclude the consideration of alternative explanations (BF) and therefore strengthen belief in a delusional account. In our cognitive model of psychosis, we propose, in common with cognitive models for other disorders, that appraisals are key to the development and persistence of psychosis. We argue that reasoning biases, such as JTC and a lack of BF, are important in that they may influence the appraisal of anomalous experiences, adverse events and distressing emotions (by limited data gathering or generation of alternatives) and thus contribute to symptom formation and maintenance (Garety *et al.*, 2001, 2007).

4.1.2 The measurement of delusional conviction and reasoning processes

Both more limited data-gathering and less belief flexibility have been shown to be associated with stronger delusional conviction (e.g. Colbert *et al.*, 2010; Freeman *et al.*, 2004, 2008; Garety *et al.*, 2005). However, this raises the issue of whether these concepts are truly distinguishable from delusional conviction. This is especially so for the concept of BF, where people need to acknowledge that they could be mistaken about their delusional belief, even if they think this is highly unlikely. In other words, is BF simply an indirect measure of delusional conviction? To our knowledge, only one study has formally examined belief flexibility (using the PM measure) in people with delusions, using non-delusional, neutral material - in this case, the belief that 'the sun will rise tomorrow, that is, that there will be another day tomorrow' (Colbert *et al.*, 2010). In this study, delusional participants

showed less willingness than a non-clinical control group to consider that they might be mistaken on this standard 'neutral' belief; suggesting that a lack of BF may be characteristic of the reasoning style of people with delusions rather than restricted to and confounded by their conviction in their delusional beliefs. However, further examination of this is clearly warranted.

The measurement of these concepts is therefore key to further investigation. A variety of measures have been used to assess delusional conviction, JTC and BF. Standard psychiatric assessments – the Positive and Negative Syndrome Scale (PANSS; Kay *et al.*, 1987) and the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984) – have typically been used to assess delusions, with conviction as an important scoring criterion. Conviction has been measured using multi-dimensional scales including the Psychotic Symptom Rating Scales (PSYRATS; Haddock *et al.*, 1999), the MADS (Wessely *et al.*, 1993) and the Explanations of Experiences interview (EoE; Freeman *et al.*, 2004). Most studies of delusional conviction have used single measures. While these measures are likely to be highly correlated, we do not know how effectively they capture the degree of belief conviction. A similar situation applies to the measurement of reasoning biases. The probabilistic reasoning task used to assess JTC has easy and difficult versions, and the content of the task also varies (e.g. Dudley *et al.*, 1997a, 1997b). BF has been measured variously with assessment of the possibility of being mistaken (PM: Wessely *et al.*, 1993), the reaction to hypothetical contradiction (RTHC: Wessely *et al.*, 1993), and the generation of alternative explanations (AE: Freeman *et al.*, 2004). There has been no formal investigation of whether these represent aspects of a common reasoning bias or how they are related to JTC.

4.2 The current study

Multivariate approaches such as structural equation modelling and factor analysis allow exploitation of the richness of multiple measurements and direct investigation of the relationships between latent constructs, controlling for the effects of measurement error in the observed responses (Bentler, 1980). Our current understanding of delusional conviction and reasoning biases in psychosis clearly

lends itself to the establishment of latent factors drawn from different instruments relating to similar constructs. For example, Bentall *et al.* (2009) recently used structural equation models with latent variables to determine the structure of relationships among psychological mechanisms potentially contributing to paranoia which found that both cognitive (including JTC) and emotion-related processes were related to paranoia. In the present study we analyse data from the Psychological Prevention of Relapse in Psychosis Trial (Garety *et al.*, 2008), in which patients with a recent relapse of psychosis were assessed at different time points, on multiple measures of delusional conviction, JTC and BF. Two earlier cross-sectional studies (Freeman *et al.*, 2004; Garety *et al.*, 2005) drew on the first 100 participants in this trial. As discussed in those two studies, it was our *a priori* plan to replicate the cross-sectional findings in the larger sample reported here and to examine changes over time. In the current study, we aimed first to examine the prevalence of JTC and of a lack of BF in this group of currently deluded patients following a recent relapse, and then to test hypotheses about their relationships with each other and with delusional conviction and over time.

The three hypotheses derived from our review of the literature were as follows:

1. Delusional conviction, JTC and belief flexibility are distinct but inter-related processes.
2. Conviction and a lack of belief flexibility will decline over time, whereas JTC is relatively stable.
3. Baseline JTC and lack of belief flexibility will predict persistence of delusional conviction over time.

4.3 Method

4.3.1 Participants

Participants were 301 patients from the Psychological Prevention of Relapse in Psychosis (PRP) Trial (ISRCTN83557988). Participants were recruited by approaching consecutive patients who had recently relapsed, whether or not they had been admitted. Two hundred and seventy three of the participants had

presentations that included delusions; 28 had hallucinations but no delusions. The PRP Trial was a United Kingdom multi-centre randomised controlled trial of cognitive behaviour therapy (CBT) and family intervention for psychosis (Garety *et al.*, 2008). It was designed to answer questions both about outcome and the psychological processes associated with psychosis over time. Inclusion criteria for the PRP Trial were the following: a current diagnosis of non-affective psychosis (schizophrenia, schizoaffective psychosis, delusional disorder), age between 18 and 65 years, a second or subsequent episode starting not more than three months before consent to enter the trial, and a rating of at least 4 (moderate severity) on the Positive and Negative Syndrome Scale (PANSS; Kay *et al.*, 1987) on at least one positive psychotic symptom at first time of meeting. Exclusion criteria were a primary diagnosis of alcohol or substance dependency, organic syndrome or learning disability, an inadequate command of English, and unstable residential arrangements. Patients were randomised into treatment as usual, treatment as usual plus CBT, and treatment as usual plus family intervention. In this treatment trial, in which Cognitive Behavioural Therapy and Family Intervention were investigated and compared with Treatment As Usual, there were no significant treatment effects on delusional outcomes or other psychotic symptoms, or on JTC and BF: only depression improved in response to CBT (Garety *et al.*, 2008). The whole sample is therefore grouped together in the current study. This report uses symptom and psychological assessments carried out at baseline, 3 months, and 12 months.

4.3.2 Measures

4.3.2.1 General psychopathology and delusions

Several clinical rating scales were used as measures of psychopathology. The Positive and Negative Syndrome Scale (PANSS; Kay *et al.*, 1987) is a 30-item rating scale developed for assessing phenomena associated with schizophrenia. Symptoms are rated over the past week. The Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984) is a 35-item rating instrument. Symptoms are rated over the past month. The Psychotic Symptom Rating Scale (PSYRATS) (Haddock *et al.*, 1999) is a 17-item scale measuring multiple dimensions of auditory hallucinations and delusions. Symptoms are rated over the past week. Good

psychometric properties have been reported for PANSS (e.g. Kay, 1990), SAPS (Andreasen, 1984; Kay, 1990), and PSYRATS (Haddock *et al.*, 1999). Four scale items were selected to derive the delusional conviction factor: the PANSS delusion item, the SAPS global delusion item, the PSYRATS delusional conviction item, and the conviction score (0-100%) on the Explanations of Experiences interview (Freeman *et al.*, 2004).

4.3.2.2 Jumping to conclusions (JTC)

In this study, three versions of the beads task were used. In the first version, individuals are presented with two jars each containing 100 coloured beads. One of the jars contains 85 beads of colour A and 15 beads of colour B, while the other jar contains 85 beads of colour B and 15 beads of colour A. Participants are told that the jars will be hidden from view and then beads will be drawn, one at a time, from just one of the jars, and will be replaced in the same jar, so that the proportions remain the same. They can see as many beads as they like before deciding which of the jars the beads are drawn from. The current study also included a more difficult version with beads in the ratio 60:40 (Dudley *et al.*, 1997a), and a version using salient words (positive and negative) in the ratio 60:40 (Dudley *et al.*, 1997b). In the salient version of the task, the beads are replaced by words ostensibly generated by a survey of the opinions of two groups of 100 about an individual. Participants are told that one group makes 60 positive comments and 40 negative comments, while the reverse is true for the other group. They have to decide which survey the words have been selected from. The variable is the number of pieces of information the participant selects before making a decision. In order to identify people with an extreme reasoning bias, the "jumping to conclusions" (JTC) bias has been defined as making a decision with two pieces of information or fewer (Garety *et al.*, 2005). We have previously adopted this categorical (dichotomous) method of assessing JTC (Garety *et al.*, 2005), since, firstly, evidence suggests that it is the extreme bias, of gathering very limited data, which particularly characterises people with delusions (Garety *et al.*, 1991) and secondly, the alternative method employed by researchers, the number of draws to decision, is not a normally distributed continuous scale, since the information value of each additional bead varies according to the colour of the bead presented and the sequence employed. However, we explored the use of both scoring methods in our factor analyses (see below).

4.3.2.3. Belief flexibility (BF)

The Maudsley Assessment of Delusions Scale (MADS; Wessely *et al.*, 1993) is a standardised interview that assesses eight dimensions of delusional experience. The belief maintenance section of the MADS enquires about the evidence for the delusion, and two of its items have been used to measure aspects of BF (the possibility of being mistaken, PM, and the reaction to hypothetical contradiction, RTHC). The evidence for the delusion cited by participants is sensitively discussed, and they are asked whether it is *at all possible* for them to be mistaken about their delusional belief. The interviewer then asks how they would react in a hypothetical situation if some new evidence were to be generated which contradicts the delusion. If they report that this would alter in any way their level of belief, this is recorded as have BF, each item dichotomously scored (yes/no). The scale has very good inter-rater reliability (Wessely *et al.*, 1993), and kappas for these two items are reported as excellent (PM: kappa = 0.91; and RTHC kappa = 0.90).

The Explanations of Experiences measure (EoE; Freeman *et al.*, 2004) is a structured interview designed to assess whether people can envisage alternative explanations for the evidence cited for their delusion. Once the evidence for the delusion is established, they are asked 'Can you think of any other explanations for the experiences that you have described? Are there any other reasons — other than [the delusional belief] — that could possibly account for these experiences even if you think they are very unlikely?' The generation of any alternative explanation (AE) (scored yes/no) is taken as a measure of BF. The current strength of the delusional explanation is rated on a conviction rating scale 'How strongly do you believe X?' (0-100%), which forms one of the conviction measures in the current study. Since this item is so similar to the MADS item, 'How sure are you about X?', the MADS conviction item was not included in the assessment battery.

4.3.3 Inter-rater reliability of clinical assessments

All assessments were conducted by research workers, after consent had been obtained. Interviews were tape-recorded for reliability and quality control purposes. Research workers met regularly with a supervisor throughout the study to maintain reliability of procedures and ratings. Reliability of clinical interview ratings was

assessed using the PANSS positive symptom score. At least one other assessor (selected from a panel of 15 raters – excluding the rater responsible for the initial assessment) re-rated 55 assessments. The number of re-ratings varied between 1 and 6, and the total number of ratings made by the 15 raters varied between 2 and 27. A linear one-way random effects model (with participant identification as the explanatory factor) was fitted by restricted maximum likelihood using Stata's xtreg procedure (version 8 for Windows) and yielded an intraclass correlation of 0.88 (95% CI 0.82–0.92). This indicates very acceptable inter-rater reliability. We also checked the reliability of ratings of the PSYRATS. The PSYRATS conviction rating simply requires the assessor to categorize the patient's percentage response into one of five ordinal categories defined by percentage numbers. There is no clinical judgement required, and inter-rater variability would not be expected. In the development of the scale, six assessors each re-rated six interviews and there was perfect reliability for the delusion conviction item (Haddock *et al.*, 1999). In the current study, seven PSYRATS interviews were re-rated and again there was perfect reliability.

4.4 Statistical Analysis

First, descriptive reports of the frequency of individual measures of reasoning biases (JTC and BF) and of levels of conviction, and their associations with each other, were generated with SPSS 15.0 for Windows (SPSS, 2006).

For the first hypothesis, that conviction and these reasoning biases are distinct but inter-related processes, both exploratory and confirmatory factor analyses were conducted using Mplus 5.2 (Muthén & Muthén, 2007) to identify and confirm the structure of conviction and reasoning biases. In order to establish the factor structure of conviction, JTC and BF, baseline measures of these variables were entered into an exploratory factor analysis (using data only from the 273 patients with delusions). The measures ('items') entered into the factor analysis were specified in Mplus as being either quantitative (the default) or categorical. For conviction, the following quantitative measures were used: PANSS delusion item (range 1-7), SAPS global delusion item (range 0-5), PSYRATS conviction item (range 0-4), and conviction score on the EoE interview (range 0-100). The

categorical (dichotomous) JTC measures were presence/absence of JTC bias on the three versions of the beads task, and the continuous measure of JTC, which we also explored, was number of beads/words drawn. For BF, binary (positive/negative) responses to the 'possibility of being mistaken' and 'reaction to hypothetical contradiction' items in the MADS interview and the 'generation of alternative explanations' item in the EoE interview were entered. A higher JTC factor score indicated a more limited data-gathering style, whereas a high BF factor score meant greater belief flexibility. In exploratory factor analysis all loadings were freely estimated, but the variances of each of the factors were constrained to be 1.

To test the second hypothesis, concerning change over time, for each of the constructs (conviction, JTC and BF), a longitudinal (repeated measures) factor analysis model was separately fitted. At each of the three time points we specified the same underlying factor. For each time point, the loading for the first variable entered into the model was set to 1 (to determine the scale). The loadings of each of the other variables (items) were freely estimated but were constrained to be the same across time points (after first establishing that these constraints did not lead to any significant loss of fit). No constraints were imposed on any of the residual (error) variances. Temporal trends in the factor scores were estimated and tested using two orthogonal contrasts created by the 'model constraint' option in Mplus – (a) C1: the difference between 3 and 12 month scores, and (b) C2: the difference between the baseline score and the average of the 3 and 12 months scores. An equivalent (global) test of trends was generated by constraining the factor scores to be equal for the three time points and comparing the chi-squares for the constrained and unconstrained models.

The third and final hypothesis was that change in conviction is predicted by JTC and BF. The same estimated factor scores were correlated with change scores for delusional conviction.

As in most longitudinal studies, there were missing data in this sample. The sample size available for each variable at each time point is specified in section 4.5.1; descriptive statistics based on these sample sizes are reported. The exploratory factor model was estimated using all available data on the component variables at baseline. The percentages of missing values in the sample (N = 273) on the key variables at baseline are as follows: 0% (PANSS delusion score), 0% (SAPS

global delusion score), 1.8% (PSYRATS conviction), 25.3% (EoE conviction), 31.5% (85:15 beads task), 32.6% (60:40 beads task), 34.8% (words task), 20.9% (possibility of being mistaken), 24.9% (reaction to hypothetical contradiction), 24.9% (alternative explanations). Mplus uses maximum likelihood (ML) estimator for continuous variables (e.g. conviction measures), and WLSMV estimator (weighted least-squares with mean and variance adjustment) for categorical variables (i.e. JTC and BF measures). ML imputes the model parameters using all available data even for cases with some missing responses, whereas WLSMV considers all available data for each pair of variables when estimating the sample statistics. There are therefore fewer missing values for the factors than for raw scores: 0% (conviction factor), 13.6% (JTC factor), and 14.7% (BF factor).

4.5 Results

4.5.1 Demographic and Clinical Data

A total of 273 patients with delusions were included in this study. Seventy percent (n = 193) of the sample was male and the mean age was 37.7 years (range 19 to 65). The sample was drawn from the following ethnic groups: White (72.2%), Black African (9.2%), Black Caribbean (7.3%), Black other (2.2%), Indian (1.8%), and other (7.3%). The major psychiatric diagnoses were schizophrenia (85.0%), schizoaffective disorder (13.6%) and delusional disorder (1.6%). They had an average length of illness of 10.78 years (SD = 8.96, range 0-44 years). The mean scores for the psychotic symptom measures at baseline and at the follow-ups are shown in Table 4.1, and indicate a moderately high level of psychotic symptoms.

At baseline, 110 (41%) participants with delusions had 100% conviction in their belief, 109 (40.7%) held the delusion with conviction between 50-99%, and 49 (18.2%) participants had less than 50% conviction in their delusion. The percentages of the sample (N = 273) rated 3 (moderate) or above on the SAPS for each subtype of delusions were as follows: persecutory delusions (57.5%), delusions of reference (55.6%), grandiose delusions (24.2%), delusions of mind reading (23.5%), religious delusions (17.6%), somatic delusions (17.2%), thought insertion (13.5%), delusions of being controlled (12.9%), thought withdrawal

(12.8%), thought broadcasting (10.6%), delusions of guilt or sin (8.4%), and delusions of jealousy (1.8%).

Table 4.1.

Mean scores (SD) of psychotic symptom and delusional conviction measures at each time point

		0 month	3 months	12 months
Psychotic symptoms	PANSS total	*n*= 273 66.64 (14.09)	*n*= 229 60.60 (14.10)	*n*= 221 59.72 (15.02)
	PANSS positive	*n*= 273 18.81 (5.00)	*n*= 229 16.44 (5.40)	*n*= 221 16.24 (6.05)
	SAPS total	*n*= 267 31.51 (16.48)	*n*= 222 23.41 (17.13)	*n*= 218 23.57 (18.24)
	PSYRATS delusion	*n*= 270 14.32 (6.44)	*n*= 228 11.00 (7.03)	*n*= 220 10.20 (7.14)
Delusional conviction	PANSS delusion	*n*= 273 4.63 (1.43)	*n*= 230 3.93 (1.57)	*n*= 221 3.74 (1.55)
	SAPS delusion	*n*= 273 3.44 (1.27)	*n*= 229 2.72 (1.58)	*n*= 221 2.72 (1.57)
	PSYRATS conviction	*n*= 268 2.98 (1.26)	*n*= 228 2.53 (1.52)	*n*= 215 2.45 (1.58)
	EoE conviction	*n*= 204 83.06 (21.96)	*n*= 179 70.17 (34.41)	*n*= 149 59.24 (38.92)

Note:

PANSS – Positive and Negative Syndrome Scale

SAPS – Scale for the Assessment of Positive Symptoms

PSYRATS – Psychotic Symptom Rating Scale

EoE – Explanation of Experiences

Reasoning biases were common. The percentages of participants who jumped to conclusions on the 85:15 beads task at baseline, 3 month and 12 month were respectively 52.4% (n = 98 out of 187), 61.8% (n = 89 out of 144), and 55.0% (n = 82 out of 149). The equivalent values for the 60:40 beads task were 40.2% (n = 74 out of 184), 44.4% (n = 64 out of 144), and 41.2% (n = 61 out of 148),

respectively. The percentages for the 60:40 words task were 38.2% (n = 68 out of 178), 43.6% (n = 61 out of 140), and 41.9% (n = 62 out of 148).

The percentages of participants who thought it was impossible that they could be mistaken about their belief at baseline, 3 month and 12 month were respectively 49.5% (n = 107 out of 216), 43.6% (n = 78 out of 179), and 42.6% (n = 66 out of 155). The percentages of participants who reacted negatively to the hypothetical contradiction (i.e. not allowing of a potential decrease in conviction if the hypothetical event were to occur) at the three time points were: 67.3% (n = 138 out of 205), 56.3% (n = 94 out of 167) and 46.2% (n = 66 out of 143). The percentages of individuals who did not give alternative explanations for their belief were 76.1% (n = 156 out of 205), 73.9% (n = 133 out of 180) and 70.7% (n = 106 out of 150).

The relationships between the individual measures at baseline are shown in Table 4.2. It can be seen that the measures of conviction are all highly significantly correlated with each other, although unsurprisingly the conviction rating from the Explanation of Experiences assessment has a relatively weaker relationship with the PANSS and the SAPS measures. There is no evidence of a relationship between the individual indicators of conviction with JTC measures, while there is evidence that higher conviction is associated with less belief flexibility. It can also be seen that the individual indicators of JTC are all highly significantly related to each other, as are those of BF; but it is clear that the relationships between the individual measures of JTC with measures of BF are generally not significantly related, with the exception of significant relationships between two of the indicators of JTC with RTHC.

Table 4.2

Pearson correlations between all baseline measures entered in the factor analysis (N = 273)

	PANSS delusion	SAPS delusion	PSYRATS conviction	EoE conviction	JTC 85:15	JTC 60:40	JTC words	PM	RTHC	AE
PANSS delusion	1									
SAPS delusion	0.79 *p*<.01	1								
PSYRATS conviction	0.74 *p*<.01	0.66 *p*<.01	1							
EoE conviction	0.35 *p*<.01	0.26 *p*<.01	0.68 *p*<.01	1						
JTC 85:15	0.08 *p*=.26	-0.05 *p*=.54	0.03 *p*=.69	0.07 *p*=.44	1					
JTC 60:40	-0.03 *p*=.69	-0.11 *p*=.15	-0.08 *p*=.32	-0.02 *p*=.79	0.50 *p*<.01	1				
JTC words	0.03 *p*=.73	-0.05 *p*=.55	-0.01 *p*=.94	-0.01 *p*=.89	0.47 *p*<.01	0.66 *p*<.01	1			

PM	-0.37	-0.23	-0.46	-0.59	-0.11	0.01	-0.09	1		
	p<.01	*p*<.01	*p*<.01	*p*<.01	*p*=.17	*p*=.93	*p*=.29			
RTHC	-0.34	-0.20	-0.25	-0.32	-0.19	-0.14	-0.23	0.56	1	
	p<.01	*p*<.01	*p*<.01	*p*<.01	*p*=.02	*p*=.10	*p*=.01	*p*<.01		
AE	-0.17	-0.06	-0.33	-0.35	-0.04	-0.07	-0.13	0.39	0.19	1
	p=.01	*p*=.40	*p*<.01	*p*<.01	*p*=.63	*p*=.41	*p*=.13	*p*<.01	*p*=.01	

Note:

PANSS – Positive and Negative Syndrome Scale

SAPS – Scale for the Assessment of Positive Symptoms

PSYRATS – Psychotic Symptom Rating Scale

EoE – Explanation of Experiences

JTC – Jumping To Conclusions

PM – Possibility of being Mistaken

RTHC – Reaction To Hypothetical Contradiction

AE – Alternative Explanations

4.5.2 Hypothesis 1: Delusional conviction, JTC and belief flexibility are distinct but inter-related processes

Table 4.3.

Comparison of factor models on conviction and reasoning

Model fit indices	1-factor model	2-factor model	3 factor model
x^2 goodness of fit	778.25 (p<.01)	138.11 (p<.01)	28.24 (p=.06)
Comparative fit index (CFI)	0.50	0.92	0.99
Root mean square error of approximation (RMSEA)	0.28	0.13	0.05

Table 4.4.

Exploratory factor analysis of baseline measures of conviction, JTC and BF – Geomin rotated factor loadings

Baseline measures	Factor 1	Factor 2	Factor 3
PANSS delusion	**0.91**	0.10	-0.01
SAPS global delusion	**0.92**	-0.00	0.16
PSYRATS conviction	**0.70**	0.01	-0.23
EoE conviction	**0.72**	-0.02	-0.29
JTC on 85:15 beads	0.02	**0.76**	-0.01
JTC on 60:40 beads	-0.01	**0.96**	0.15
JTC on words	-0.03	**0.91**	-0.01
PM	0.30	0.00	**1.41**
RTHC	-0.05	-0.32	**0.60**
AE	0.01	-0.10	**0.53**

Note:

Factor loadings > ±0.4 are in boldface

Exploratory factor analysis was performed on the four measures of conviction, the three measures of JTC and the three measures of BF. (For JTC, we initially performed the EFA using both our preferred dichotomous method of

scoring (JTC: two beads or fewer; no JTC: over two beads) and a continuous measure (number of beads drawn), but found that the dichotomous scoring method resulted in a better chi square test of model fit. We have therefore used the factors from the dichotomous scoring of JTC in all the following analyses.) As shown in Table 4.3, a three-factor model fitted the data best. Moreover, the factor loadings shown in Table 4.4 indicate that the three factors clearly represent delusional conviction, JTC, and BF respectively.

For the conviction factor, since the PSYRATS and EoE items are specific measures of delusional conviction but the PANSS delusion item and the SAPS global delusion score are measures that combine several dimensions of delusional experience along with conviction, the residuals of the last two items were set to be correlated in the factor model, so that the resultant factor reflects level of delusional conviction. The model fit indices showed that the conviction factor model with correlated residuals is a better fit than the model without the correlations (see Table 4.5).

Table 4.5.

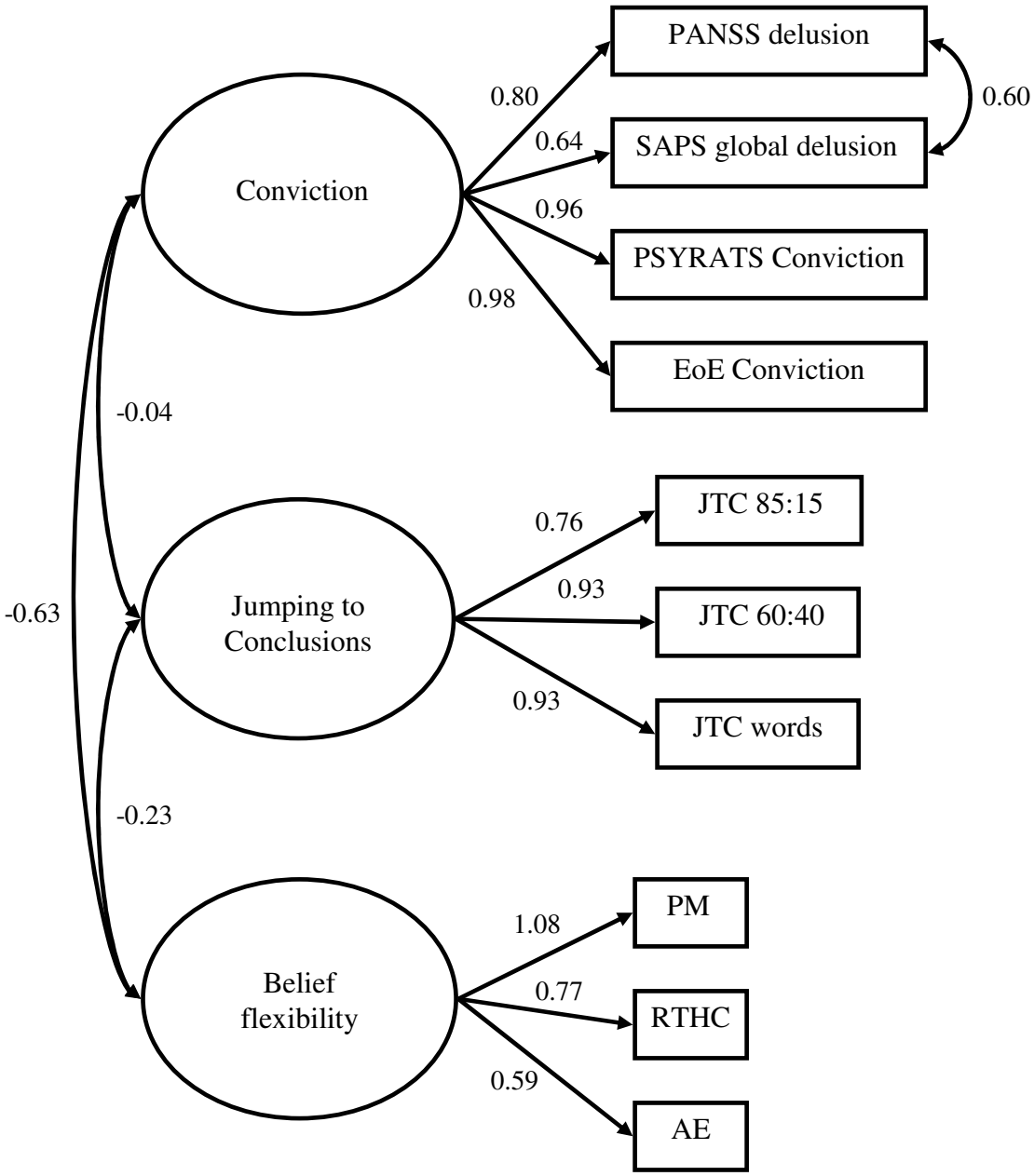
Comparison of measurement models on baseline conviction

Model fit indices	Model without correlation	Model with correlation
x^2 goodness of fit	90.55 ($p < .01$)	1.71 ($p = .19$)
Comparative fit index (CFI)	0.90	1.00
Root mean square error of approximation (RMSEA)	0.40	0.05

Confirmatory factor analysis was then performed on the baseline conviction and reasoning bias variables. Figure 4.1 shows the new structure of the three factors with standardised estimates of factor loadings and correlations between factors.

Figure 4.1

Final factor structure and loadings (standardised estimates) of conviction, JTC and belief flexibility following confirmatory factor analysis



Based on the structure of the three factors, factor scores across time points were estimated using longitudinal factor analysis models for each of the three concepts separately. The mean factor scores for each factor at the three time points are as follows: Conviction (n = 273) (4.64, SD=1.10; 3.91, SD=1.21; 3.73, SD=1.18); JTC (n = 236) (0.17, SD=1.04; 0.61, SD=1.03; 0.29, SD=1.28); BF (n = 233) (0.08, SD=1.70; 0.40, SD=1.55; 0.60, SD=2.04). Correlations between the estimated factor scores at each time point are shown in Table 4.6. There are very

strong correlations within the JTC and BF factors across time points, consistent with their being stable over time, whereas the correlations within the conviction factor over time, while significant, are lower, indicating less stability (see below). Conviction factor scores are correlated with BF factor scores at all time points (i.e. greater conviction is associated with less belief flexibility), but not with JTC factor scores at any time point. There is a weak correlation between BF factor score at baseline and JTC factor scores at baseline and 12 month (i.e. greater JTC bias is associated with less belief flexibility; see Table 4.6).

Table 4.6.

Correlation between factor scores at each time point (N = 273)

		Conviction			Jumping to conclusions			Belief flexibility		
		0m	3m	12m	0m	3m	12m	0m	3m	12m
Conviction	0m									
	3m	.53**								
	12m	.31**	.55**							
Jumping to	0m	.03	.05	.07						
conclusions	3m	.09	.07	.04	.88**					
	12m	.10	.05	.07	.84**	.93**				
Belief flexibility	0m	-.40**	-.40**	-.30**	-.14*	-.12	-.14*			
	3m	-.34**	-.51**	-.33**	-.11	-.11	-.13	.87**		
	12m	-.29**	-.43**	-.47**	-.11	-.10	-.12	.79**	.86**	

Note:

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

4.5.3 Hypothesis 2: Conviction and a lack of belief flexibility will decline over time, whereas JTC is relatively stable

Changes in factor scores over time were analysed by creating two contrast parameters in the longitudinal factor analysis models: (1) the contrast between factor means at 3 months and 12 months; and (2) the contrast between baseline factor mean and the average of 3 months and 12 months. Tests of contrasts showed that there was no significant change in the conviction factor score between 3 and 12 months (mean change 0.19; s.e. 0.12; p= .12) but that there was a highly-significant change between baseline and the average of the two follow-up values (mean change 0.81; s.e. 0.10; p< .01). In this case the equality constraints for the factor loadings over time were not supported by the data. This had practically no effect on the conclusions, however (mean factor change between 3 and 12 months 0.19; s.e. 0.12; p= .12, and the mean change between baseline and the average of 3 and 12 months 0.81; s.e. 0.10; p< .01). But note that although the model with time-varying factor loadings fitted reasonably well according to the CFI (0.97) and RMSEA (0.08) criteria, the fit was not good according to the chi-square value (135.73 with 48 degrees of freedom). On the PSYRATS, 38.4% of the sample showed a decrease in delusional conviction, 42.7% showed no change, and 18.9% showed an increase over the year of follow-up. 34.4% (n = 31) participants maintained 100% conviction in their beliefs throughout the 12 months.

Tests of contrasts showed no significant change in the JTC factor score between 3 and 12 months (mean change 0.33; s.e. 0.24; p= .17), or between baseline and average of the 3 and 12 months values (mean change -0.29; s.e. 0.20; p= .16) – the chi-square test for the equality of factor scores at the three times being 3.91 with 2 d.f. (p> .05). The fit of the model with time-invariant factor loading was very good – indicated by a CFI of 1, an RMSEA of 0 and a chi-square of 20.90 with 28 degrees of freedom.

Likewise, there was no significant change in BF factor scores between 3 and 12 months (mean change -0.21; s.e. 0.37; p= .58), or between baseline and the average of 3 and 12 months (mean change -0.49; s.e. 0.30; p= .10). The chi-square for constraining for the factor scores to be the same for all three time points was 3.22 with 2 d.f. (p> .05). The fit of the model with time-invariant factor loading was good

as indicated by a CFI of 0.98, an RMSEA of 0.06 but some lack of fit suggested by a chi-square of 40.81 with 24 degrees of freedom.

In summary, there was some evidence of an overall decline in delusional conviction, but none in either JTC or BF.

4.5.4 Hypothesis 3: Baseline JTC and lack of belief flexibility will moderate change in conviction over time

As shown in Table 4.6, the baseline JTC factor score did not significantly correlate with the conviction factor score at any time point (p = .65 [baseline], .41 [3 months], .28 [12 months]). In contrast, the baseline BF factor score correlated negatively with conviction factor score at all time points ($p < .01$ at all time points) i.e. individuals with inflexible beliefs at baseline had higher levels of conviction at all time points.

Calculation of Pearson correlations indicated that changes in the factor scores for conviction were not significantly correlated with baseline values of the JTC factor, $r = 0.03$ ($p = .65$) and $r = 0.04$ ($p = .56$), for the changes between 0 and 3 months and between 0 and 12 months, respectively, or the BF factor for the change between 0 and 12 months, $r = -0.04$ ($p = .52$), though the correlation between baseline BF and change in conviction in the first three months reached trend level, $r = -0.13$ ($p < .06$).

4.6 Discussion

Cognitive models of delusions have placed an emphasis on reasoning processes, and this is the largest study so far on this topic. Almost three hundred people with delusions were repeatedly assessed on multiple measures of delusion conviction, jumping to conclusions and belief flexibility. The sample was of patients who had had at least two acute episodes, and these individuals typically had a lengthy history of psychotic symptoms. If, as cognitive models assert, delusions are maintained by biased reasoning, such biases should be especially apparent. This was confirmed. At the first assessment, 50% of participants showed jumping to conclusions on the standard beads task, while a similar proportion thought they could

not be mistaken in their belief. These proportions are consistent with the smaller studies reported previously.

While previous studies have reported correlations between delusional conviction and reasoning biases, this is the first time that multiple measures have been put together to examine their factor structure. Three distinct factors of conviction, JTC and BF emerged, suggesting that the measures used here, along with many of the different measures reported previously, are tapping distinct and coherent constructs. Method variance may have played some part in these results and possibly inflated the effects – two of the constructs were assessed by binary variables and one by quantitative scoring; and JTC was assessed by a delusion-unrelated cognitive task rather than by delusion-focussed interview. Whether other methods would so clearly replicate these three constructs is an empirical question. Another limitation was the amount of missing data. Clearly, a more complete data set would have been preferable, and replication of the results is necessary, but the way in which factor analysis models make allowance for missing data is a strength of this statistical method.

We have also clarified the relationship between these constructs. The inability to think that the delusion could be at all incorrect and to generate alternative explanations for events is distinct from high levels of belief conviction. Belief flexibility is therefore not merely a refined method of assessing delusional conviction. Belief flexibility was nevertheless associated at all time points with the degree of delusional conviction, and especially highly negatively correlated at baseline, consistent with our earlier report (Garety *et al.*, 2005). Conviction and belief inflexibility, at least when assessed directly with regards to the delusions, are understandably linked and share common variance. How then are they different? We can illustrate the point by considering the proportion of the 110 people in our sample with 100% conviction at baseline who affirmed that they may or may not be mistaken on the Possibility of being Mistaken (PM) measure. Approximately one quarter (23%) with 100% conviction scored positively on PM: 'I am fully convinced but can concede that I may be mistaken'; this differs from: 'I am fully convinced and it is impossible that I am mistaken' which was found in the remaining 77%. People can be equally convinced that they are correct in asserting a given belief, but differ in their relationship to that conviction.

Contrary to our previous report, we did not find that jumping to conclusions was associated with higher level of delusional conviction (Garety *et al.*, 2005). This may be because JTC is simply only one of many processes contributing to delusional conviction over time. JTC is clearly related to the presence of delusions, but these data suggest that levels of conviction may be more closely related to and possibly influenced by the relatively independent processes of belief flexibility. The main finding in relation to JTC is that in a large group, prone to enduring high conviction beliefs, there were significant levels of JTC. There were also indications of modest relationships between belief flexibility and JTC, as was expected.

The study group had all experienced a recent relapse of psychosis, and it is striking that the delusions and reasoning biases were so persistent over the period of follow-up. Although conviction was less stable, in that there was a significant decrease in the conviction factor score in the first three months, the decrease was small, and substantial levels of symptoms remained. Despite receiving treatment, one-third of the group held their delusions with 100% certainty throughout the year of assessment and only about one-third of participants showed a decrease in delusional conviction. Moreover there were no significant changes in both the reasoning biases. Reasoning biases and conviction were thus hardly affected by a year's treatment with medication and, for some in this study, psychological therapy. No previous studies have reported on the stability of belief flexibility, while our findings concerning the stability of JTC are consistent with other reports (e.g. Peters & Garety, 2006). It is noteworthy here that both JTC and belief flexibility are stable whereas conviction may change – an inflexible way of thinking or limited data gathering do not improve as the delusional conviction reduces, but are enduring. There is, however, some weak evidence, that belief flexibility predicts conviction change, in that there was a marginally significant association between baseline belief flexibility and change in conviction at 3 months, consistent with earlier research findings (e.g. Garety *et al.*, 1997). Flexible thinking may render the person more open to experiences or ideas which change their conclusions. However, a limitation of this study is that what could be learned about the relationships between changes in delusional conviction, belief flexibility and jumping to conclusions was unexpectedly severely curtailed by the relative stability of the variables of interest.

How can this work be taken forward? There are two clear routes. One is to carry out a similar observational study in patients more likely to show change over time, for instance, in individuals with at risk mental states, patients in early contact with services, or patients entering a prodromal phase. It would be of interest to assess JTC and belief flexibility for delusion-related and neutral materials and to address the limitations of method variance noted above. Assessment of meta-cognitive beliefs about decision-making and executive functioning abilities to learn about the cognitive factors related to reasoning biases would also be of interest. The second route is more clinically relevant, and that is to alter reasoning biases using precisely targeted interventions and examine the effects on delusional beliefs. That is, to take a manipulationist or interventionist – causal model approach (Kendler & Campbell, 2009), thereby potentially providing stronger causal evidence for a role of reasoning biases in delusion maintenance. Reasoning biases are clearly evident in the sample, and even for those not showing the extreme forms, it is likely that if more careful data-gathering and consideration of alternative explanations could be encouraged then this may help produce a shift from a delusional perspective. The study indicates that increasing data-gathering may be one of several potential techniques that will assist in enabling greater belief flexibility, which is the reasoning process most closely tied to degree of belief in the delusional idea. Potentially appropriate techniques are currently being developed (e.g. Moritz *et al.*, 2010b; Ross *et al.*, 2011; Waller *et al.*, 2011).

Addendum to Chapter 4 – Comparison of JTC bias in psychotic patients with and without delusions

Chapter 4 was an investigation of factor structure and longitudinal relationship between delusional conviction, JTC and BF. Since the hypotheses focussed on changes in delusional conviction, only the 273 patients with delusions in the Psychological Prevention of Relapse in Psychosis (PRP) trial were included. Following the publication of this study (So *et al.*, 2012), an additional analysis was performed which was relevant to the overall aim of the thesis i.e. role of JTC in the development of delusions. Previous studies (e.g. Garety & Freeman, 1999; Garety *et al.,* 2005) have suggested that JTC is associated with delusions. Therefore, the aim of this analysis was to compare the level of JTC bias in psychotic patients with and without delusions, with the hypothesis that JTC bias is greater in psychotic patients with delusions than in those without. The sample consisted of the same 273 patients with delusions as in Chapter 4 and the rest of the PRP trial sample (n = 28) who had hallucinations but did not have delusions at any of the time points throughout the 12-month study period.

In order to test this hypothesis, the longitudinal JTC factor model which was used to estimate JTC factor scores (see section 4.5.2) was fitted to the data in the total sample (N = 301), where a new dummy variable was created to represent the absence of delusion (0 = *deluded*; 1 = *non-deluded*). Using this model, the absence of delusions was used to predict JTC factor score at each of the three time points (at baseline, and at 3 and 12 months follow-up).

The mean JTC factor scores for the group with delusions were: 0.19 (SD = 1.05) at baseline, 0.62 (SD = 1.02) at 3 months, and 0.20 (SD = 1.13) at 12 months. The mean JTC factor scores for the patients without delusions were: -0.16 (SD = 1.08) at baseline, 0.13 (SD = 1.06) at 3 months, and -0.47 (SD = 1.14) at 12 months. The absence of a delusion significantly predicted JTC factor scores at 3 (β = -1.13, SE = 0.57, p = .05) and 12 (β = -1.880, SE = 0.783, p = .02) months but not at baseline (β = -0.62, SE = 0.58, p = .29), indicating that the deluded group showed a hastier decision-making style at two of the three time points.

Although JTC was not associated with a higher level of conviction (see section 4.5.2), it was generally higher in those with current delusions. This

indicates that JTC contributes to the development of delusions. While many JTC studies compared deluded individuals with non-deluded psychiatric controls (Dudley *et al.*, 1997a; Fear & Healy, 1997; Huq, Garety, & Hemsley, 1988; Peters & Garety, 2006), this analysis is a more stringent test of the specific role of JTC in delusions because multiple measures were analysed in a multivariate approach and the comparison group also had active psychotic symptoms, i.e. hallucinations. Our finding also supports the view that JTC is specifically related to the presence of delusions and not the diagnosis of schizophrenia (Moritz & Woodward, 2005; Peters & Garety, 2006; Peters *et al.,* 2008; Van Dael *et al.,* 2006).

Chapter 5

Study 3: Changes in delusions, belief flexibility and aberrant salience in the first two weeks of antipsychotic medication

5.1 Introduction

In this thesis, changes in delusions have been examined in 40 participants in an acute phase over eight weeks of antipsychotic treatment (Study 1), and in 273 participants following a recent relapse of psychosis over a 12 months' period (Study 2). Consistent with a large-scale meta-analysis and randomised trials (Agid *et al.*, 2003; Leucht *et al.*, 2005a), Study 1 found that delusions improved most markedly in the early weeks of antipsychotic treatment and that changes in the first two weeks predicted overall symptom improvement. Study 1 also found an improvement in all delusional dimensions (including conviction) over time, which was not consistent with Mizrahi *et al.* (2006). As discussed in Chapter 3, one possible explanation for the discrepancy in results was the use of different measures of conviction. Considering that the greatest symptom improvement takes place in the first two weeks of antipsychotic treatment, and that having a good multi-dimensional assessment of delusions is crucial, the present study (Study 3) aimed to focus on the process of change in delusional dimensions over the two-week critical period, with a more fine-grained analysis using both clinical ratings and the experience sampling method (ESM; Delespaul, 1995; Myin-Germeys *et al.*, 2009).

The literature review and Studies 1 and 2 in this thesis found a strong association between belief flexibility (BF) and delusional conviction, and some improvement in BF during treatment (see also Freeman *et al.*, 2004; Garety *et al.*, 2005). While improvement in BF during treatment has been measured using the Maudsley Assessment of Delusions Scale (MADS; Taylor *et al.*, 1994), it is an open question whether BF fluctuates within a day. Given that BF is closely associated with the level of conviction, and conviction varies across environments (Myin-Germeys *et al.,* 2001a; Peters *et al.,* 2011), it is of interest to explore the possibility of measuring momentary levels of BF in the flow of daily life and to examine the temporal relationship between BF and conviction over two weeks in the initial phase of antipsychotic treatment.

While delusional conviction is associated with BF, it has been suggested that delusional distress and preoccupation may be associated with aberrant salience (see Chapter 1, Section 1.3.1). Kapur (2003; Kapur *et al.*, 2005) suggested that psychosis is "a somewhat novel and perplexing state marked by exaggerated

importance of certain percepts and ideas", and delusions are "a 'top-down' cognitive explanation that the individual imposes on these experiences of aberrant salience in an effort to make sense of them" (Kapur, 2003, p. 15). According to this theory, antipsychotics "block dopamine and dampen the salience of the preoccupying symptoms", so that new aberrant salient experiences are less likely to form and previously acquired aberrant salient experiences are more likely to extinguish (Kapur & Mamo, 2003). Antipsychotics do not change delusional ideas primarily, and patients work through their symptoms towards a "psychological resolution" (Kapur *et al.*, 2006). In keeping with this "salience hypothesis", patients reported that antipsychotics helped by "detaching" them from the psychotic symptoms rather than "eradicating" the symptoms per se (Mizrahi *et al.,* 2005). Therefore, it would be expected that both aberrant salience and delusional distress and preoccupation would improve with antipsychotics. Aberrant salience has been assessed in patients with schizophrenia using an experimental paradigm, the Salience Attribution Test (SAT) (Roiser *et al.*, 2009). In this reward learning task, aberrant salience was calculated by the difference between response latency and subjective reinforcement probability ratings for task-irrelevant stimuli. Roiser *et al.* (2009) found greater aberrant salience in patients with delusions than in patients without delusions. However, change in aberrant salience in response to antipsychotic treatment has not been examined before. The present study aimed to develop a self-report assessment of aberrant salience based on Kapur and colleagues' (2005, 2006) notion of the concept, and to examine changes in aberrant salience and its relationship with delusional distress and preoccupation during antipsychotic treatment.

Studies 1 and 2 reported that the 'jumping to conclusions' (JTC) bias did not respond to antipsychotic and did not improve over a 12 months' period. This is consistent with other studies, which have suggested that JTC is a stable trait (e.g. Peters & Garety, 2006). However, the finding that JTC was not associated with delusional conviction and did not predict improvement in conviction was not fully consistent with previous studies (e.g. Garety *et al.*, 2005; Menon *et al.*, 2008). Based on patients' performance on probability tasks including the 'beads' task, it has been suggested that individuals who jump to conclusions have a lower threshold for making decisions and tend to revise decisions/ probability estimates when

confronted with potentially disconfirming information (Garety *et al.*, 1991; Moritz *et al.*, 2009; Moritz & Woodward, 2005; Peters & Garety, 2006; Rubio *et al.*, 2011). Using ESM, the role of JTC as a predictor of change and fluctuations in conviction will be examined.

5.2 Experience sampling method (ESM)

ESM is a structured diary technique, assessing current context and psychological experiences in the realm of daily life (Csikszentmihalyi & Larson, 1987; Delespaul, 1995; deVries, 1992; Myin-Germeys *et al.*, 2009). A general description of this methodology is available in Chapter 1 (Section 1.4.2). This method is particularly well-suited for investigating delusions, since they may fluctuate over time and in response to internal and contextual stimuli. Fluctuations in delusional experiences have been reported by Myin-Germeys *et al.* (2001a), who asked participants to describe their spontaneous thought (just before the signal went off), and to rate on the following on ESM: preoccupation ("I'm preoccupied by my thoughts right now"), suspicion ("My thoughts are suspicious"), and feeling controlled ("My thoughts are being influenced"). The content of the thought was also coded as pathological or not. A moment was identified as delusional if the thought content was coded as pathological or if the response to any of the three ESM items was above cut-off. Using these criteria, Myin-Germeys *et al.* (2001a) found that chronic patients with schizophrenia experienced delusions around one-third of the time. However, it is possible that a moment was defined as delusional if preoccupation was high even though the content of the thought was not pathological, i.e. the participant may have been preoccupied with other, non-delusional thoughts. To examine fluctuations in the same delusion over time, a potentially superior way would be to elicit the specific content of the belief in an interview and phrase the ESM items according to the wording used by the participant. Using this method, Peters *et al.* (2011) assessed dimensions of hallucinations and delusions in 12 out-patients with psychosis over six days. They found that conviction and appraisals of psychotic symptoms were highly variable, and that delusional dimensions were associated with each other (although the associations between other dimensions and conviction were the weakest). The present study aimed to use a similar methodology in an acute sample.

The present study is novel in several ways. While delusional dimensions have been measured using ESM before (Peters *et al.*, 2011), BF and aberrant salience have not. Therefore, new ESM measures of these constructs have been developed. In addition, the present study is to our knowledge the first ESM study with in-patients during an acute delusional episode, at the beginning of their antipsychotic treatment. The duration of assessment period (two weeks) is also the longest among ESM studies on patients with psychosis which typically cover six days (see Myin-Germeys *et al.*, 2003a, 2009; Oorschot *et al.*, 2009, for reviews).

5.3 Study aims and hypotheses

The current study aimed to explore the feasibility and validity of using ESM as a method to measure delusional dimensions, BF and aberrant salience in patients with acute psychosis. It also aimed to examine fluctuations of these constructs and their inter-relationships over two weeks at the beginning of antipsychotic treatment.

Primary hypotheses were as follows:

1. Delusional distress and preoccupation (but not delusional conviction) will reduce significantly over two weeks of antipsychotic treatment
2. Delusional distress and preoccupation will be associated with aberrant salience cross-sectionally and over time
3. Change in delusional conviction over time will be associated with a higher level of belief flexibility

This study will also examine the following exploratory, secondary hypotheses:

4. Within the same day, there will be an association between conviction at one assessment point and belief flexibility at the next assessment point, and vice versa
5. There will be an association between JTC bias at baseline and fluctuations in delusional conviction and belief flexibility over time

5.4 Method

5.4.1 Participants

Ethical approval for the study was granted by the South East London Research Ethics Committee 4 (ref. 10/H0807/44) and a copy of the approval letter is included in Appendix 1. In-patients with acute delusions (scoring 4 or above on at least one of the PANSS delusion items) and a clinical diagnosis (based on clinical notes) of schizophrenia spectrum disorder or bipolar disorder were recruited. Sufficient understanding of English and ability to use a Personal Digital Assistant (PDA) was required to complete the study procedures. Patients with drug-induced psychosis or organic psychosis, and patients with a primary diagnosis of substance misuse were excluded. The first assessment took place as soon as patients were admitted to the hospital, and no longer than two weeks after the start of antipsychotic treatment for the current psychotic episode.

5.4.2 Measures

5.4.2.1 ESM

5.4.2.1.1 Items

This section introduces the ESM measures used (see Table 5.1) as well as the issues that were considered when designing the study.

Table 5.1

ESM items

Section	Question	Response
Environment	*The following question concerns where you are right now.* 1. Where are you right now?	□ In my home or hospital room □ Public area in the hospital □ At someone else's home □ Outside e.g. street, shop □ Other
Affect	*The following questions ask about how you are feeling at this moment.* 2. How cheerful do you feel right now? 3. How irritated do you feel right now?	 1 (not at all) – 7 (very much) 1 (not at all) – 7 (very much)

	4. How relaxed do you feel right now?	1 (not at all) – 7 (very much)
	5. How content do you feel right now?	1 (not at all) – 7 (very much)
	6. How low do you feel right now?	1 (not at all) – 7 (very much)
	7. How tense do you feel right now?	1 (not at all) – 7 (very much)
Psychotic symptoms	*The following questions ask about your thoughts or experiences at this moment.*	
	8. Other than conversations with other people, do you hear voices right now?	1 (not at all) – 7 (very much)
	9. Do you see images right now?	1 (not at all) – 7 (very much)
	10. How suspicious do you feel right now?	1 (not at all) – 7 (very much)
	11. How well can you concentrate right now?	1 (not at all) – 7 (very much)
	12. How safe do you feel right now?	1 (not at all) – 7 (very much)
Delusion	*The following questions concern the problem discussed with your researcher, in particular the thought or idea that … (to be suffixed as agreed at the baseline interview)*	
	13. At this moment, to what extent do you believe this concern is true?	1 (not at all) – 7 (very much)
	14. At this moment, how much does this concern upset you?	1 (not at all) – 7 (very much)
	15. At this moment, to what extent does this concern go round and round in your mind?	1 (not at all) – 7 (very much)
	16. At this moment, to what extent does this concern interfere with what you are doing?	1 (not at all) – 7 (very much)
	17. At this moment, to what extent do you think there are other possible explanations for this concern?	1 (not at all) – 7 (very much)
	18. At this moment, to what extent do you think you may be mistaken about this concern?	1 (not at all) – 7 (very much)
	19. Since the last signal, have you noticed anything that makes you question this concern?	1 (not at all) – 7 (very much)

Aberrant salience	*The following questions concern how you are experiencing different thoughts or events right now.* 20. At this moment, how much do things around you grab your attention? 21. At this moment, how much do you feel that everything seems to have some meaning? 22. At this moment, how much do you notice things that you have not noticed before?	 1 (not at all) – 7 (very much) 1 (not at all) – 7 (very much) 1 (not at all) – 7 (very much)
Company	*The following questions concern who you are with right now.* 23. Who is with you right now?	□ Nobody (you are alone) □ Family or friends □ Hospital staff □ Other patients □ Strangers or other people
Activity	*The following questions concern the most significant or important activity you performed since the last signal.* 24. Which of your activities do you feel was the most important? 25. To what extent did you find this activity pleasant? 26. To what extent did you find this activity stressful?	□ Nothing or sleeping □ Eating or personal hygiene □ Ward activity/seeing doctors □ Going out of hospital □ Other activity 1 (not at all) – 7 (very much) 1 (not at all) – 7 (very much)
Reactivity to ESM (only in the last diary of the day)	*Please give us your opinion about responding to these questionnaires today.* 27. To what extent did completing these questionnaires influence your mood today? 28. To what extent did responding to these questions change your regular activities today? 29. To what extent was this an ordinary day for you?	 1 (not at all) – 7 (very much) 1 (not at all) – 7 (very much) 1 (not at all) – 7 (very much)

Since the sample consisted of patients in an acute psychotic episode who had not been stabilised with antipsychotics, care was taken to make sure that the self-assessment forms were easy to complete, with each diary entry taking no longer than three minutes to complete. The ESM questions were carefully constructed and phrased so as to facilitate self-assessment of momentary experiences. Items were organised into sections on positive and negative affect, psychotic symptoms, delusional dimensions, belief flexibility, and aberrant salience (see Table 5.1 for the list of items). The name of the sections did not appear in the questionnaire, and labels such as delusions and hallucinations were not used in the questionnaire or interviews. In order to orientate participants between sections of items, each section began with a statement introducing what the following questions were about, e.g. "The following questions ask about how you are feeling at this moment". Each diary consisted of the same set of questions, while three additional questions were asked at the last report of each day about the participant's reactivity to conducting the ESM assessment.

The ESM items on psychotic symptoms and affect were determined with reference to previous ESM studies (e.g. Kimhy *et al.*, 2006; Myin-Germeys *et al.*, 2001a, 2001b, 2005). Items on delusional dimensions (conviction, distress, preoccupation, disruption) were worded according to each participant's delusional belief, as agreed in the baseline interview. These four dimensions were selected because they have been reported as major dimensions of delusions (Garety & Hemsley, 1987; Lincoln, 2007; Peters *et al.,* 2004) and are also measured on PSYRATS (Haddock et al., 1999). This section began with the statement: "The following questions concern the problem discussed with your researcher, in particular the thought or idea that…" followed by the exact wording of the 'problem or main concern' as described by the participant. Only one 'problem or main concern' was selected and rated on throughout the study period. The wording of the dimensions was similar to that used in Peters *et al.* (2011).

As suggested by Palmier-Claus *et al.* (2011b), items on contextual information (e.g. 'where am I'?, 'who am I with?') were also included so as to ensure that the participant was not solely focusing on his/her symptoms and that the diary was not only about emotionally salient information. Both positively and negatively worded items (e.g. pleasant, stressful) were used.

New items were devised to assess belief flexibility (BF) and aberrant salience. One item on BF, i.e. Possibility of being Mistaken (PM), was drawn from the Maudsley Assessment of Delusions Scale (MADS) which has been used in this thesis and previous studies (Freeman *et al.*, 2004; Garety *et al.*, 2005). However, the item Reaction to Hypothetical Contradiction (RTHC), which was included in the MADS interview, was not included in the ESM diary because this item involves reflective evaluation of a hypothetical scenario suggested by the researcher and is not an appropriate item for ESM. Therefore, the ESM assessment of BF included the following three items: Possibility of being Mistaken (PM), generation of alternative explanations (AE), and experience of event(s) disconfirming the belief. AE has been used as a measure of BF in the Explanation of Experiences interview (Freeman et al., 2004), and was also included in Study 2 of this thesis (see section 4.1.2). Experience of events disconfirming the belief was included because it has been shown that patients with delusions were less responsive to disconfirmatory evidence than controls (e.g. Woodward *et al.,* 2006), and discarding disconfirmatory evidence was considered in Freeman *et al*'s (2002) model as an important factor maintaining persecutory delusions.

For aberrant salience, a list of items was generated based on the descriptions of the construct in Kapur *et al.*'s papers (2003, 2005, 2006) (i.e. attention-grabbing, novelty, exaggerated importance), which were then narrowed down and refined by a panel of experts (SK, PG, EP), which included the proponent of the salience hypothesis. By the time this study began, the Aberrant Salience Inventory (ASI; Cicero, Kerns, & McCarthy, 2010) was developed. Although the ASI included the concepts described in Kapur's work, it had 29 items and was designed to measure "trait aberrant salience which can be used in non-clinical samples" (p. 689). The items were phrased in a reflective way, e.g. "Do you sometimes feel…", "Do you ever notice that…" Therefore, this scale was not suitable for assessment of moment-by-moment changes of aberrant salience. It was decided that, as a first ESM study investigating changes in aberrant salience, this study would include only three items tapping into attention-grabbing, novelty, and exaggerated importance respectively, with the items phrased in a way that was suitable for momentary assessments.

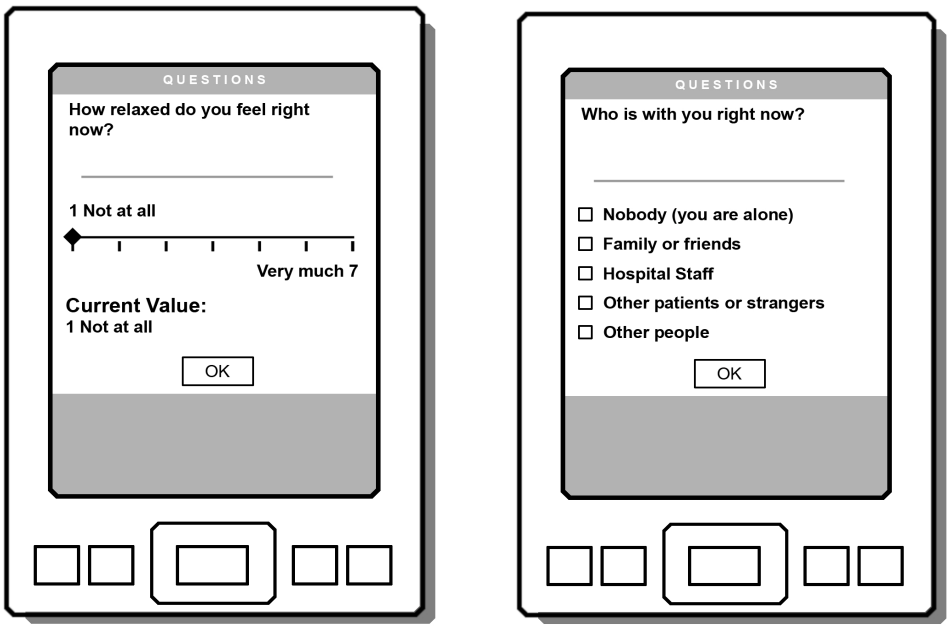
The full list of items was reviewed in detail by experts in the areas of reasoning and the ESM methodology. Wording for some items was changed and the items were re-ordered so that the assessment began with a situational question so as to draw the participant's attention to the here-and-now, and ended with questions involving evaluation of the activity preceding the beep. The revised version was then piloted with two individuals from the general population for feasibility and clarity, after which wording of the items was further simplified to ease comprehension. The final list of items is shown in Table 5.1.

5.4.2.1.2 Protocol

In order to obtain time-stamped data and avoid back-filling of reports (Broderick *et al.,* 2003; Stone *et al.,* 2003), the assessment was conducted electronically on a Personal Digital Assistant (PDA) rather than using pen-and-paper booklets. The modified version of the Purdue Momentary Assessment Tool software (version 2.1.2) (Weiss *et al.*, 2004) was used to present questions and collect responses on the PDAs.

Figure 5.1

ESM screenshots



A signal-contingent protocol was used where participants were asked to complete a diary entry by a signal at various times throughout the day. Signal-contingent protocols are recommended for assessing experiences that are on-going, susceptible to retrospective memory bias or cognitive regulation (Conner Christensen *et al.*, 2003). In order to capture various moments during the day and to avoid clustering of responses, time points were randomised within a block period. Specifically, the 12 target hours each day were divided into seven blocks of approximately 90 minutes. One signalling time was selected for every block using random numbers generated by the computer, with the proviso that no signals should occur within 20 minutes of each other. Since participants woke up at different times in the day, the beep schedule was adjusted according to individual lifestyle. An early schedule was from 9am to 9pm, while a late schedule was from 11am to 11pm. Since the aim of the study was to assess momentary experiences, the PDA programme permitted responses to be provided only within 20 minutes following the signal (and two minutes following each question), and all data entries were time-stamped. If they did not complete the report within this time window, the PDA was programmed to turn off automatically until the next activation. In this way it was not possible for participants to rate their experiences in retrospect, hence avoiding memory bias.

Most of the items were rated on seven-point Likert scales (from 1 "not at all" to 7 "very much) where the participant had to indicate their responses on a graphical slider (see Figure 5.1). For contextual questions, the participants were asked to respond by ticking one of the several boxes (see Figure 5.1). The questions and response options were arranged in a way that only one item appears on the screen each time and that participants did not have to scroll up or down the screen to read all the information on that item. In order to save the battery, all other functions/ programmes in the PDA were disabled during the study period.

5.4.2.2 Symptomatology and delusional dimensions

Apart from ESM, psychotic symptoms were also measured using three well-validated symptom scales, namely the Schedule for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984), the Positive and Negative Syndrome Scale (PANSS; Kay *et al.*, 1987), and the Psychotic Symptom Rating Scales (PSYRATS; Haddock *et al.*, 1999). PANSS and PSYRATS have been described in detail in

Chapter 3 (p. 70), and the items are in Appendix 3 (p. 271-272). SAPS is a 35-item interview-based scale of 32 positive symptoms of schizophrenia (see Appendix 3, p. 275). The SAPS consists of four areas: hallucinations, delusions, bizarre behaviour and positive formal thought disorder. Each area includes ratings of specific symptoms and a global rating. Symptoms over the past week are rated. Each symptom is rated on a six-point (0-5) scale, and total scores range from 0 to 175. The SAPS has been reported to have good inter-rater reliability and test-retest reliability, and moderate to high internal consistency (for global summary scores and total scores respectively) (Schuldberg *et al.*, 1990).

5.4.2.3 Belief flexibility

Belief flexibility (BF) was measured at three time points (baseline, week 1, and week 2) using the two items from the Maudsley Assessment of Delusions Scale (MADS; Garety *et al.*, 2005; Wessely *et al.*, 1993) – Possibility of being Mistaken (PM) and Reaction to Hypothetical Contradiction (RTHC) (See Chapter 3, p. 73, for items).

5.4.2.4 Jumping to conclusions reasoning bias

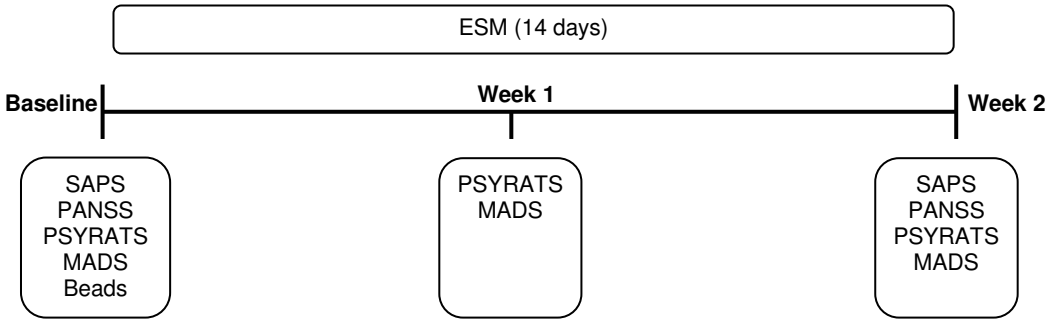
This study included both the easier (85:15) and the harder (60:40) versions of the beads task (see Chapter 3, p. 74 for detail of the task). In order to reduce the demand on working memory and prevent any potential confound with memory function, the tasks included a memory aide, in which the previous beads drawn were shown (Dudley *et al.*, 1997a). Informed by Study 1 about the stability of JTC, the construct was measured at baseline only in this study.

5.4.3 Procedures

As shown in Figure 5.2, participants were interviewed as soon as they began antipsychotic treatment (baseline), one week and two weeks after. In addition, they were asked to complete the ESM assessment for 14 days.

Figure 5.2

Assessment schedule for study 3



After providing written informed consent, participants were interviewed and completed the baseline measures. In this interview, the researcher agreed with the participant on the index delusional belief (labelled as "the problem or main concern") to be rated on the delusion-related ESM questions. The participant also decided whether they would opt for the early or late beeping schedule.

After the baseline assessment, the participant was trained to conduct the computerised ESM procedure, including the operation of the PDA and the meaning of all questions and response choices. The researcher completed at least one practice diary entry together with the participant. Participants were told that they should carry around the PDA with them and complete the report as soon as possible after each signal. Typical situations in which this might be difficult (e.g. in a shower, meeting the doctors) were discussed, and the importance of responding to all the beeps was emphasised.

Once the participants expressed confidence in completing the assessment on their own, the individually designed questionnaire was then programmed onto a Palm Tungsten E2 PDA (Palm OS® version 5.2.1). Participants were given the PDA and a charger to carry with them and the ESM measurements began right away. The maximum number of potential signals a participant would receive was 98 (seven signals per day for 14 days). However, since the assessment began right after the baseline interview which took place at different times of the day, some participants received more signals than the others on the first day. Previous studies have set the criterion that participants' data were excluded from data analysis if they completed fewer than 33% of the experience sampling activations (Delespaul, 1995;

Myin-Germeys *et al.*, 2001a, 2001b). In this study, the minimum compliance criterion was rounded to 30.

In order to ensure that the participant understood and complied with the procedure, the researcher contacted the participant at least twice in the first week to offer support. Individuals who demonstrated difficulty in understanding assessment questions or operating the device were given additional training. Participants were interviewed at one week and two weeks after the beginning of the ESM assessment, and were encouraged to contact the researcher by phone if they encountered any problems during the assessment period.

5.5 Statistical analysis

Statistical analysis of this study involved clinical data at three time points and ESM data across 14 days, capturing both within- and between-individual differences. Unilevel analyses of changes in clinical ratings were performed using paired-sample *t*-tests on the Statistical Package for the Social Sciences (SPSS) 15.0 (SPSS, 2006).

The ESM data sets contain repeated observations nested within participants. Since observations from the same individual are more similar than observations from different individuals, the residuals are not independent. Therefore, longitudinal relationships of variables across levels (beep and person) were evaluated using multilevel linear regression modelling (Goldstein, 1987; Snijders & Bosker, 1999), which is a standard method for analysing ESM data (Gable, Reis, & Elliot, 2000). Regression models were tested using the multilevel XTREG command in STATA 10 (StataCorp, 2007) and the hierarchical linear and nonlinear modelling in HLM 7 (Raudenbush, Bryk, & Congdon, 2010). While multilevel linear models were used for continuous outcomes (e.g. delusional dimensions), Bernoulli models were used for dichotomous outcomes (e.g. missingness of variables). These analyses take into account the variance components of two different levels, adjusting for dependencies among observations generated by each individual. The B coefficient from these models is the fixed regression coefficient of the predictor in the multilevel model, and can be interpreted in the same way as in the conventional unilevel regression analysis. All analyses adjusted for the

effects of age and gender. Whenever mean levels of ESM scores are presented (e.g. in graphs), scores were calculated for each participant and then averaged.

The first set of multilevel modelling analysis aimed to investigate changes in psychotic symptoms and delusional dimensions over time (Hypothesis 1). Separate regression models were estimated with each of the symptoms/dimensions as dependent variables (DV) respectively and day as an independent variable (IV).

For Hypothesis 2, the relationship of aberrant salience with distress and preoccupation was tested cross-sectionally and over time. To text the cross-sectional relationship between aberrant salience and delusional dimensions, the first multilevel linear regression model included the summary score of aberrant salience as the DV, and delusional distress and preoccupation as IVs. The second model tested the effect of time on aberrant salience, with the aberrant salience summary score as the DV and day as the IV. The next two models tested the longitudinal relationship with the aberrant salience summary score as the DV and the following IVs: Model 1 – day, distress, day x distress interaction; Model 2 – day, preoccupation, day x preoccupation. For all models including an interaction effect, main effects will be reported only when the interaction effect is not significant. This is because main effects represent the independent effect of each independent variable controlling for other independent variables. In models where the interaction effect is significant, main effects will not be interpretable.

In order to test Hypothesis 3, i.e. that fluctuations in delusional conviction were associated with a higher level of BF, two approaches to the analysis were taken. The first was to examine the relationship between momentary levels of conviction and BF as measured by the two dichotomous items in the MADS at baseline, namely Possibility of being Mistaken (PM) and Reaction to Hypothetical Contradiction (RTHC), rated as 1 = positive/flexible, and 0 = negative/not flexible). Two separate Bernoulli regression models were fitted with the ESM level of conviction as the DV, and PM/RTHC, day, and their interactions as IVs. The second approach was to examine the association between momentary ESM levels of conviction and BF in the flow of daily life. A linear regression model was estimated with conviction as the DV, and day, BF summary score, and day x BF interaction as IVs. In order to further investigate the direction of prospective association between conviction and belief flexibility (Hypothesis 4), ESM responses

were time-lagged so that models of change were tested with the IV at any given assessment (T0) predicting the DV at the subsequent assessment on the same day (T1), controlling for the score of the DV at T0. The prospective association between BF and conviction was examined using a multilevel regression model with conviction at T1 as the DV, BF summary score at T0 as the IV, and conviction at T0 as the covariate. Prospective associations in the reverse direction (i.e. conviction at T0 predicting BF at T1) were also tested in a separate model.

For Hypothesis 5, participants were grouped by their performance on the beads task. To test the effect of baseline JTC on fluctuations in conviction over time, two separate multilevel linear regression models were estimated with JTC, day, and JTC x day interaction as IVs, and the level of conviction and within-day standard deviation (day-SD) of conviction as DVs respectively. Two other linear regression models were also tested with the level and day-SD of BF summary score as DVs, and JTC, day, and JTC x day interaction as IVs.

5.6 Results

5.6.1 Demographic and Clinical Data

A total of 68 in-patients who had delusions and were at the beginning of their antipsychotic treatment were approached, among whom 26 consented to participate in this study. Half of the sample was male and half female. Mean age was 36.12 years (range 20-63 years). Psychiatric diagnoses from the case notes were available for 22 patients as follows: nine patients were diagnosed with schizophrenia, five with unspecified psychosis, three with mood disorder with psychotic symptoms, two with schizoaffective disorder, one with schizophreniform disorder, one with delusional disorder, and one with acute and transient psychotic disorder. The average number of admissions (including the current one) was 1.72 (SD = 1.54; range = 1-7). The average number of days on antipsychotics at the time of the first assessment was 4.91 (SD = 2.93; range 0-13); 20 of the 26 patients were assessed within the first week of treatment. The average baseline rating of delusion on the SAPS was 3.96 (SD = 0.53), indicating a moderate to marked level of severity (Andreasen, 1984). Data on medication type were available for 21 patients as follows: 19 were on atypicals (Risperidone, Olanzapine, Aripiprazole, Quetiapine,

Amisulpiride, and Clozapine), while two were on typical antipsychotic (Clopixol and Piportil). The mean starting dose of antipsychotics in chlorpromazine equivalents (Andreasen *et al.*, 2010) was 162.1mg/d (SD = 88.1). Reasons for the lack of medication information for the other five patients include patients' refusal to permit the researcher access to their case notes and medication charts not being available.

Baseline mean scores on the PANSS were as follows (N = 26): Positive = 20.88 (SD = 4.19), Negative = 11.85 (SD = 5.38), General = 31.50 (SD = 9.04), Total = 64.23 (SD = 14.41), indicating a "mildly ill" to "moderately ill" level of severity (Leucht *et al.*, 2005).

Nineteen participants (valid percentage 76.0%) showed a 'jumping to conclusions' (JTC) bias on the 85:15 beads task, making a decision after seeing two beads or fewer. On the 60:40 version of the beads task, 15 participants (valid percentage 65.2%) showed the JTC bias. 52% and 65% made a decision after viewing one bead only on the 85:15 and 60:40 tasks respectively. Mean number of beads drawn before decision was 2.68 (SD = 3.87) on the 85:15 task, and 3.96 (SD = 5.63) on the 60:40 task. Twenty two participants (valid percentage 88.0%) gave the correct response on the 85:15 task, and 20 (valid percentage 87.0%) gave the correct response on the 60:40 task.

For belief flexibility, 15 participants (57.7%) were rated negative (i.e. not flexible) on both Possibility of being Mistaken (PM) and Reaction to Hypothetical Contradiction (RTHC) as measured by the MADS at baseline, four participants (15.4%) were rated positive (i.e. flexible) on both, three (11.5%) were positive on PM and negative on RTHC, three (11.5%) were positive on RTHC and negative on PM, and one (3.8%) was positive on PM but did not complete RTHC.

5.6.2 Feasibility, validity and reliability of the ESM assessment

5.6.2.1 Feasibility

Out of the 26 participants, five refused to complete the ESM assessment after one day and discontinued from the study. Respective reasons for refusal were

as follows: the beeps were considered annoying, the PDA was lost, glasses went missing and the participant could not read properly, physical illness, and being paranoid about the assessment. Out of the 21 participants who then continued on the ESM and interviews, five completed only 2 to 23 entries, and were therefore not included in the analysis. The remaining 16 participants met the minimum compliance criterion, completing 30 or more diary entries. There was no significant difference between the 16 participants who met the minimum compliance requirement for ESM completion and the ten participants who did not in age, duration and dosage of medication, number of admissions, and all scale scores in the PANSS, SAPS and PSYRATS ($p > .10$). Responses to the MADS measures of BF and the beads task (both versions) were also not different between the groups ($p > .05$). Diagnoses in the two groups were: Schizophrenia (35.7% in ESM completers and 50% in non-completers), Unspecified psychosis (21.4% in completers and 25% in non-completers), Mood disorder with psychotic symptoms (14.3% in completers and 12.5% in non-completers), Schizoaffective disorder (14.3% in completers and 0% in non-completers), Delusional disorder (7.1% in completers and 0% in non-completers), Acute and transient psychotic disorder (7.1% in completers and 0% in non-completers), and Schizophreniform disorder (0% in completers and 12.5% in non-completers).

Among the 16 participants who completed ESM, the mean number of entries per participant was 59 (range 34-89), out of a potential maximum of 98. The mean rate of compliance was 70.7% (range 40.2-94.6%). The total number of observations available for multi-level models was 1,306.

To the question "To what extent did completing these questionnaires influence your mood today?", the average rating was 3.40 (SD = 2.11) on a 1-7 point scale. To the question "To what extent did responding to these questions change your regular activities today?", the average rating was 2.98 (SD = 2.23) on a 1-7 point scale. Fatigue effect was examined using a Bernoulli model with the logit-link function with missingness as dependent variable, and Day as independent variable. There was no significant change in missingness over time (B = 0.02, SE = 0.02, $p > .10$).

5.6.2.2 Internal consistency

Since this was the first study using ESM in patients with acute delusions for as long as 14 days, and assessing psychological constructs such as belief flexibility and aberrant salience, an analysis was conducted to examine the inter-item consistency within and between constructs (see Table 5.1). The internal consistency of the ESM items for each construct was examined using the participants' mean values on Day 1. The mood adjectives 'Cheerful', 'Relaxed' and 'Content' formed a Positive Affect scale (Cronbach's $\alpha = 0.91$), and the items 'Irritated', 'Low' and 'Tense' formed a Negative Affect scale (Cronbach's $\alpha = 0.79$). The items 'Alternative explanations', 'Possibility of being Mistaken' and 'Disconfirming experience' formed a BF scale (Cronbach's $\alpha = 0.93$), and items 'Attention grabbing', 'Meaning' and 'Novelty' formed an Aberrant salience scale (Cronbach's $\alpha = 0.77$). These Cronbach's α indicate acceptable to excellent inter-item consistency (George & Mallery, 2003). Therefore, a summary score was generated for each of these constructs and analyses were done using summary scores. Delusional dimensions were not grouped as one construct because of the evidence for the multi-dimensionality of delusions and for associations between specific dimensions with psychological processes (see Chapter 1).

5.6.2.3 Divergent validity

As a test of the divergent validity of the ESM assessment, associations between scores of items from opposite constructs were tested using multi-level linear regression modelling. A significant and negative association was found between Cheerful and Low ($B = -0.09$, $SE = 0.03$, $df = 1306$, $p < .01$) and between Relaxed and Tense ($B = -0.09$, $SE = 0.03$, $df = 1306$, $p < .01$). Although the negative association between these items was expected, the regression coefficients indicate a weak association.

5.6.2.4 Convergent validity

An analysis was conducted to examine the within-individual association between ESM scores for hallucinations and delusions on Day 1 and the clinical ratings at the baseline interview for specific psychotic symptoms (n = 15). ESM scores for each variable were averaged within the day. The mean ESM level of Voices on Day 1 did not correlate with the SAPS Auditory Hallucinations (AH)

item (r = 0.24, p = .39) or the PSYRATS AH subscale at baseline (r = 0.27, p = .32). The mean ESM level of Images on Day 1 correlated with SAPS Visual Hallucinations item at trend level (r = 0.50, p = .06). Correlation of the mean ESM level of Suspiciousness on Day 1 was positive and significant with the SAPS Persecutory delusions item (r = 0.56, p = .03) and with the PANSS Suspiciousness item (r = 0.51, p = .05).

Pearson correlation coefficients between PSYRATS ratings at baseline and ESM ratings on Day 1 for each of the delusional dimensions were as follows: Conviction (r = -0.29, p = .29), Distress (r = -0.35, p = .21), Preoccupation (r = 0.12, p = .67), and Disruption (r = 0.49, p = .07).

For BF, participants who showed positive and negative BF on the MADS at the baseline interview were compared on their mean level of ESM belief flexibility summary score on Day 1. Independent-samples t-test showed that individuals grouped by their responses to the MADS Possibility of being Mistaken (PM) item showed no significant difference in the ESM level of BF (t = -0.57, df = 12, p = .58). However, there was a trend that individuals who responded positively (i.e. more flexible) on the MADS Reaction to Hypothetical Contradiction (RTHC) item at baseline actually had a lower level of BF (i.e. less flexible) on the ESM (t = -2.07, df = 12, p = .06).

In summary, ESM assessment and interview ratings at baseline were consistent for suspiciousness, partially consistent for images, and not consistent for voices, delusional dimensions and BF. Although the association was not significant, it was in the predicted direction for voices and two of the four dimensions. Peters *et al.* (2011) also reported that ESM measures of psychotic symptoms were not completely comparable to PSYRATS scores. They argued that ESM is more sensitive and ecologically valid than interview-based assessments, as it captures psychological functioning as it unfolds in the natural environment. Therefore, a lack of consistency between measures does not necessarily indicate a lack of validity for ESM items. On the other hand, the inverse relationship between ESM level of BF and the two interview-based assessments of BF (one of which was of trend significance and the other not significant) cast doubt about the validity of the participant ESM items on BF.

5.6.3 Changes in psychotic symptoms over two weeks

5.6.3.1 Clinical ratings

As shown in Table 5.2, there was a significant improvement in PANSS positive, general and total scores between the two assessment time points, as well as in delusions as assessed on the PANSS, SAPS and PSYRATS. Changes in hallucinations were inconsistent, with improvement shown in ratings on PANSS and PSYRATS, but not on SAPS.

Table 5.2

Mean levels (SD) of symptom ratings at baseline and week 2 (N = 16)

	Baseline	2 weeks	Paired-sample *t*-test
PANSS Positive	20.63 (4.52)	16.25 (3.72)	$t = 4.01$, $p < .01$
PANSS Negative	11.88 (5.24)	10.00 (3.58)	$t = 1.57$, $p = .17$
PANSS General	33.25 (10.51)	24.75 (5.16)	$t = 3.78$, $p < .01$
PANSS Total	65.75 (16.10)	51.00 (10.91)	$t = 4.06$, $p < .01$
PSYRATS Delusions	17.25 (3.92)	13.69 (3.63)	$t = 3.20$, $p < .01$
SAPS Delusions	4.00 (0.52)	3.13 (1.15)	$t = 3.22$, $p < .01$
PANSS Delusions	5.38 (1.03)	4.31 (1.01)	$t = 3.44$, $p < .01$
PANSS Hallucinatory behaviour	3.19 (1.94)	2.31 (1.70)	$t = 3.05$, $p = .01$
PSYRATS Auditory hallucinations	13.38 (18.02)	9.06 (14.24)	$t = 2.23$, $p = .04$
SAPS Voices	2.19 (2.29)	1.63 (2.36)	$t = 1.78$, $p = .10$
SAPS Images	0.63 (1.03)	0.88 (1.71)	$t = -0.85$, $p = .41$

5.6.3.2 ESM

Multilevel regression modelling showed a significant increase over time in Voices (B = 0.03, SE = 0.01, $p = .02$) and Images (B = 0.03, SE = 0.01, $p = .01$), but no change in Suspiciousness ($p > .10$).

5.6.4 Hypothesis 1: Delusional distress and preoccupation (but not delusional conviction) will reduce significantly over two weeks of antipsychotic treatment

5.6.4.1 Clinical ratings

As shown in Table 5.3, there was a significant reduction in Distress and Disruption. Change in Conviction or Preoccupation was not significant.

Table 5.3

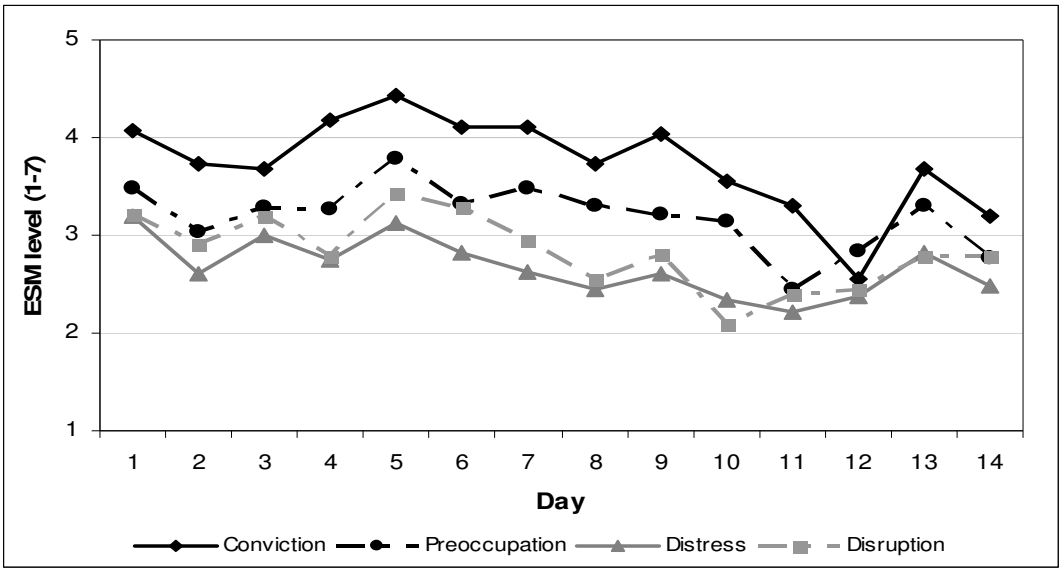
Mean scores (SD) on PSYRATS (N = 16)

	Baseline	2 weeks	Paired-sample *t* test
Conviction	3.38 (0.62)	3.25 (1.07)	$t = 0.46$, $p = .65$
Distress	3.03 (1.24)	2.13 (1.38)	$t = 2.52$, $p = .02$
Preoccupation	2.31 (0.93)	1.91 (0.69)	$t = 1.71$, $p = .11$
Disruption	3.19 (0.54)	2.38 (1.03)	$t = 3.57$, $p < .01$

5.6.4.2 ESM

Figure 5.3

Changes in delusional dimensions on ESM (N = 16)



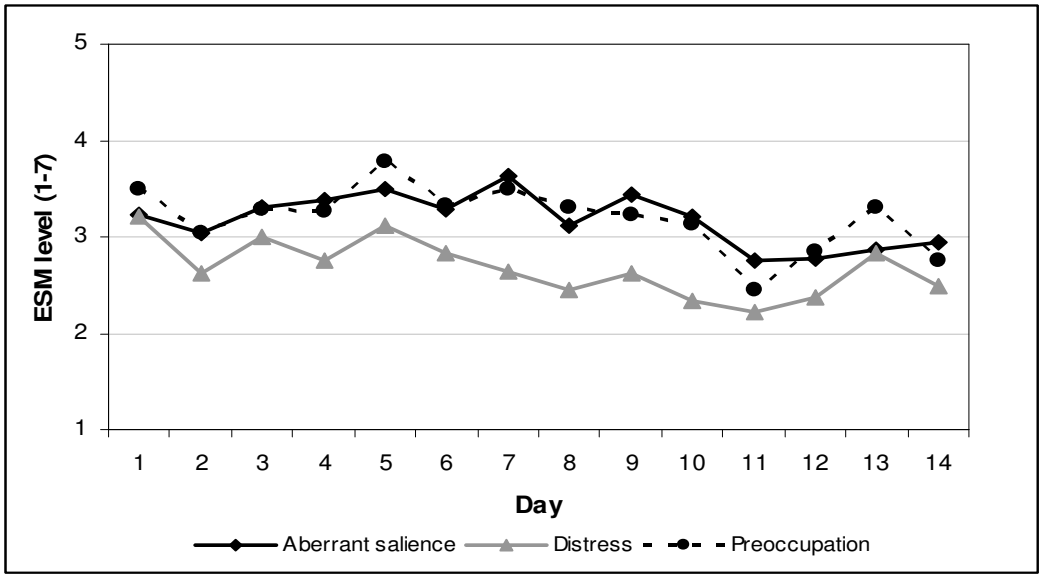
ESM levels of delusional dimensions are shown in Figure 5.3. Multilevel linear regression models showed a significant decrease in Distress (B = -0.04, SE = 0.01, $p < .01$) and Disruption (B = -0.03, SE = 0.01, $p = .01$), but not in Conviction or Preoccupation ($p > .10$). This is consistent with the finding using PSYRATS. Models with a quadratic term for time (i.e. squared Day) were tested, and the quadratic effect of time was not significant ($p > .10$). Therefore, there was a linear decrease in distress and disruption across days.

5.6.5 Hypothesis 2: Delusional distress and preoccupation will be associated with aberrant salience cross-sectionally and over time

The mean levels of the Aberrant salience summary score (i.e. average of the three ESM items on Aberrant salience), and Delusional distress and Delusional preoccupation as a function of time are presented in Figure 5.4.

Figure 5.4

Changes over time in aberrant salience, delusional distress and preoccupation (N = 16)



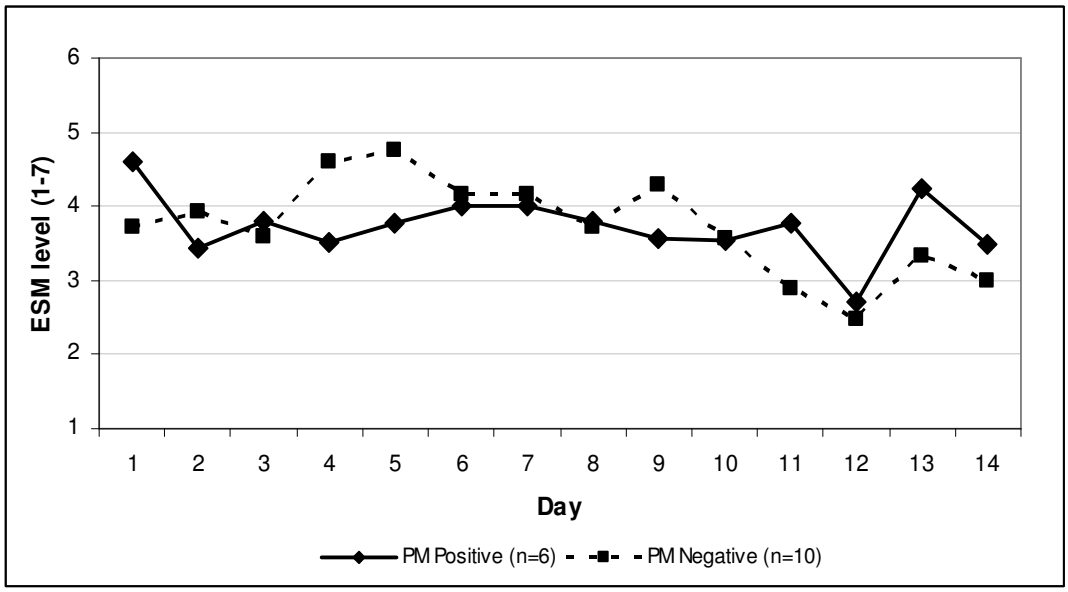
Cross-sectionally, Aberrant salience was positively associated with Distress (B = 0.20, SE = 0.03, $p < .01$) and Preoccupation (B = 0.25, SE = 0.03, $p < .01$). In the model predicting Aberrant salience by Day, change in Aberrant salience over time was not significant ($p > .10$). In the model where Aberrant salience was predicted by Day, Distress and Day x Distress interaction, there was a significant interaction effect of Day and Distress on Aberrant salience (B = 0.02, SE = 0.004, $p < .01$), indicating that the association between Aberrant salience and Distress became stronger over time. Similarly, in the model where Aberrant salience was predicted by Day, Preoccupation and Day x Preoccupation interaction, there was a significant interaction effect of Day and Preoccupation on Aberrant salience (B = 0.02, SE = 0.004, $p < .01$), indicating an increase in the relationship between Aberrant salience and Preoccupation over time.

5.6.6 Hypothesis 3: Change in delusional conviction over time will be associated with a higher level of belief flexibility

5.6.6.1 Relationship between baseline belief flexibility (on MADS) and ESM level of conviction

Figure 5.5

Change over time in conviction by baseline response to Possibility of being Mistaken (N = 16)

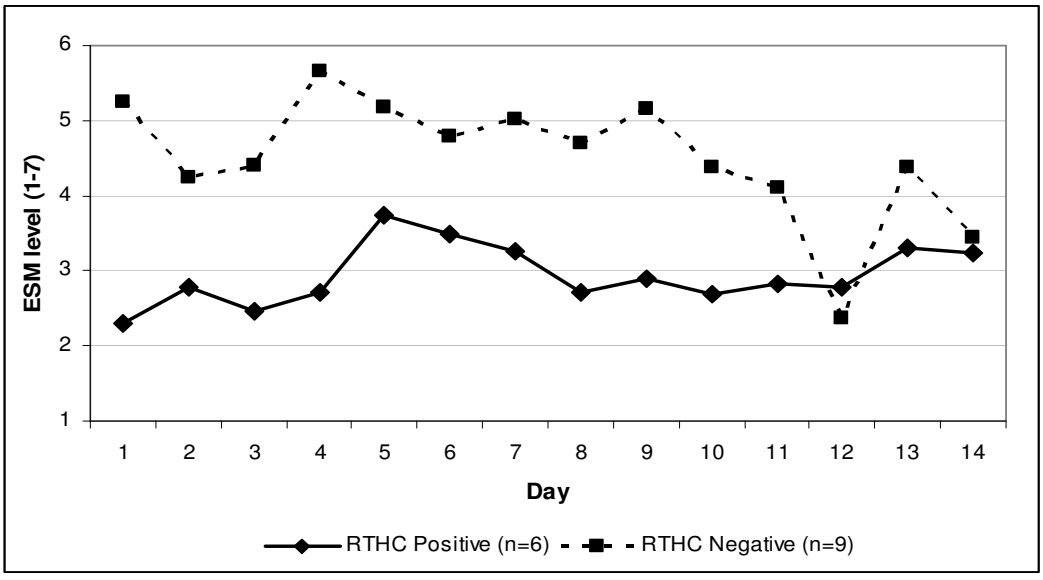


The ESM levels of conviction by baseline BF on the two MADS items (Possibility of being Mistaken – PM; Reaction to Hypothetical Contradiction – RTHC) are presented in Figures 5.5 and 5.6. There was no significant interaction between Day and baseline MADS PM on Conviction (B = 0.05, SE = 0.03, p = .07). The main effect of Day was significant (B = -0.04, SE = 0.02, p = .03), but that of baseline MADS PM was not (p > .10). Therefore, there was a reduction in conviction over time (holding PM constant), and the reduction did not differ between the PM-positive and PM-negative groups.

On the other hand, there was a significant interaction between Day and baseline MADS RTHC in predicting Conviction (B = 0.06, SE = 0.03, p = .04), indicating that change in conviction over time was significantly different between the two RTHC groups, with conviction increasing in the RTHC-positive group and decreasing in the RTHC-negative group (see Figure 5.6).

Figure 5.6

Change over time in conviction by baseline response to Reaction to Hypothetical Contradiction (N = 15)



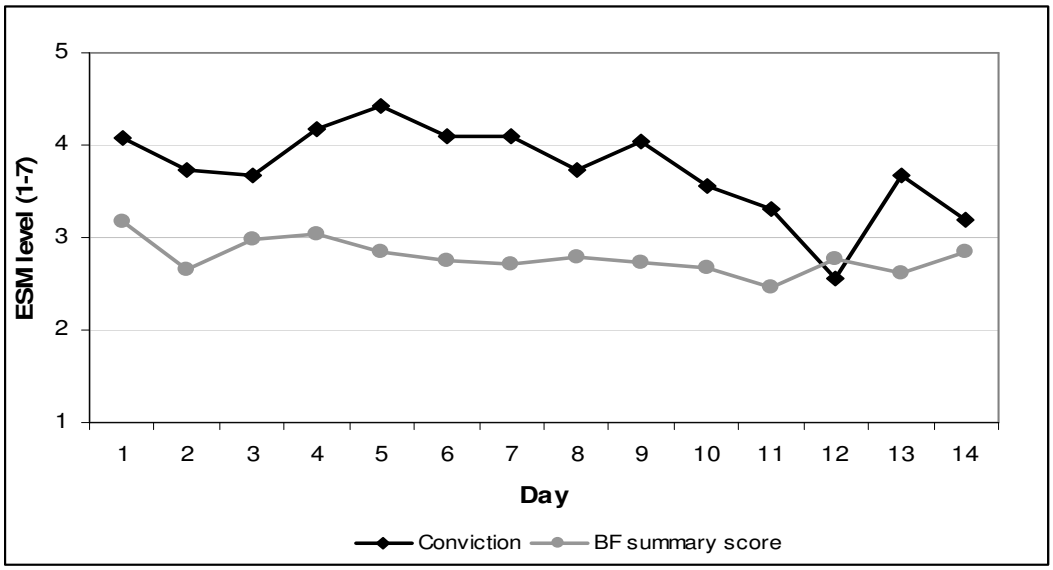
5.6.6.2 Relationship between momentary levels of belief flexibility and conviction on the ESM

The mean ESM levels of BF summary score (i.e. average score of the three BF items on the ESM) and conviction are shown in Figure 5.7. There was a significant interaction between Day and ESM level of BF in predicting Conviction

(B = 0.02, SE = 0.01, $p < .01$), indicating a greater association between ESM levels of BF and conviction over time. Note that a higher level of conviction was associated with a higher level of flexibility, which was in the opposite direction to the analysis using baseline MADS BF data.

Figure 5.7

Change over time in belief flexibility summary score and conviction on the ESM (N=16)



5.6.7 Hypothesis 4: Within the same day, there will be an association between conviction at one assessment point and belief flexibility at the next assessment point, and vice versa

Using within-day time-lagged data on the ESM, multilevel models were tested with BF summary score at T0 predicting conviction at T1, controlling for conviction at T0. Observations when T1 was the first signal of the day or where items were not completed were excluded from these models, resulting in a total number of 614 observations. After controlling for the effect of Conviction at T0 (B = 0.31, SE = 0.05, $p < .01$), BF summary score at T0 predicted Conviction at T1 significantly (B = 0.11, SE = 0.06, $p = .05$). A separate model tested the prediction

in the reverse direction. After controlling for the effect of BF at T0 (B = 0.27, SE = 0.04, $p < .01$), Conviction at T0 did not predict BF at T1 (B = 0.05, SE = 0.03, $p > .10$). Therefore, a higher momentary level of BF predicted an increase in conviction at the next ESM assessment within the day, but not the other way round. Again, the association between more flexibility and higher conviction was not consistent with the analysis using baseline BF data.

5.6.8 Hypothesis 5: There will be an association between JTC bias at baseline and fluctuations in delusional conviction and belief flexibility over time

Among the 16 participants who completed the ESM assessment, 14 (valid percentage 87.5%) showed the JTC bias on the 85:15 beads task and eight (valid percentage 57.1%) on the 60:40 beads task. Considering that the percentage of JTC on the 85:15 task among the ESM participants was unusually high compared to previous studies, and that grouping participants based on their performance on the 85:15 would lead to great imbalance in group sizes, the sample was grouped based on their 60:40 task performance (JTC = 8, no JTC = 6). There was no difference between the JTC and non-JTC group on errors on the 85:15 (chi-square = 1.84, df = 1, $p = .18$) nor on the 60:40 (chi-square = 1.84, df = 1, $p = .18$) tasks.

5.6.8.1 Relationship between JTC and conviction

The ESM levels of conviction in individuals who showed the JTC bias on the 60:40 beads task and those who did not are presented in Figure 5.8. There was a significant interaction between JTC and Day on Conviction (B = 0.10, SE = 0.03, $p < .01$). The main effect of Day was significant (B = -0.07, SE = 0.02, $p < .01$) and that of JTC was not (B = 0.98, SE = 1.01, $p > .10$). Therefore, conviction change over time was different between the two JTC groups, with an increase in conviction in the JTC group and a decrease in the no-JTC group.

Within-day variability (i.e. SD) of conviction in individuals who showed the JTC bias on the 60:40 beads task and those who did not is presented in Figure 5.9. There was a significant interaction between Day and JTC in predicting within-day variability of Conviction (B = 0.08, SE = 0.04, $p = .04$). The main effect of Day

was significant (B = -0.08, SE = 0.03, $p < .01$), but that of JTC was not significant ($p > .10$). Therefore, change in variability of conviction over time was different between the two JTC groups, with more variability in the JTC group.

Figure 5.8

Change over time in conviction by baseline JTC on the 60:40 beads task (N = 14)

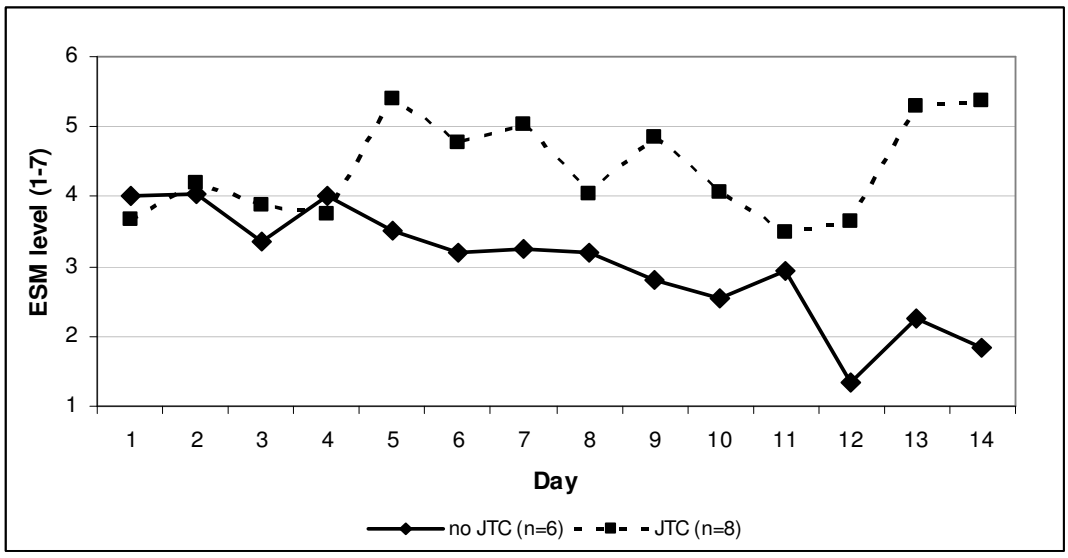
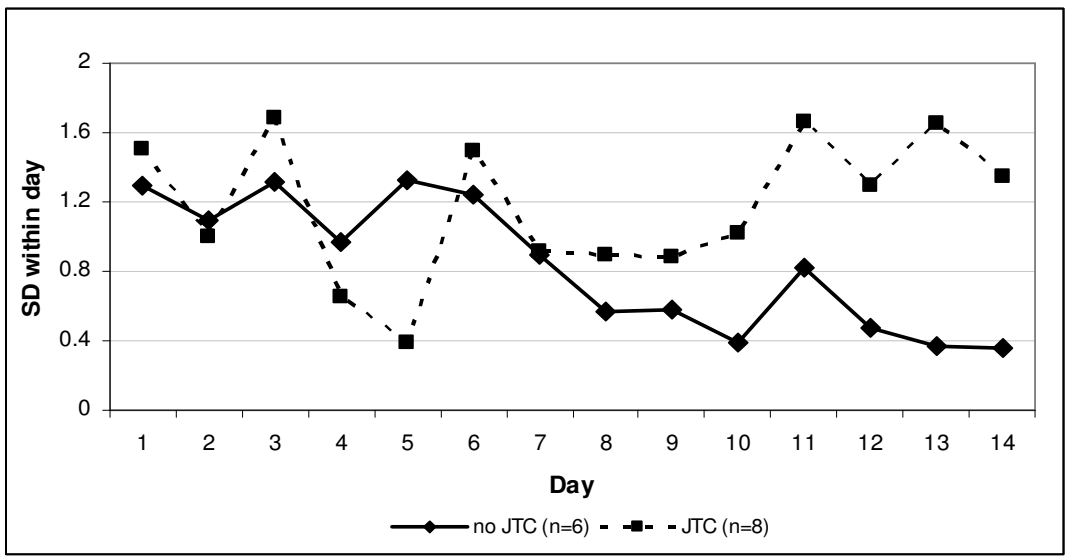


Figure 5.9

Within-day variability (measured by SD) of conviction by baseline JTC on the 60:40 beads task (N = 14)

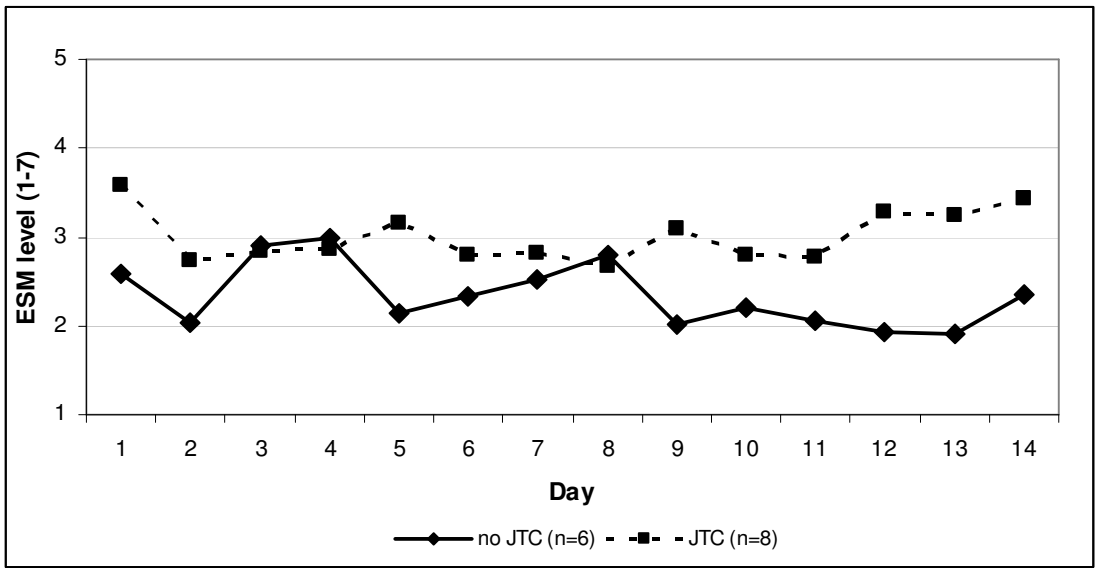


5.6.8.2 Relationship between JTC and belief flexibility

The ESM levels of BF summary score in individuals who showed the JTC bias and those who did not are presented in Figure 5.10. There was a significant interaction between JTC and Day on BF (B = 0.08, SE = 0.02, $p < .01$). Therefore, change in BF over time was different between the two JTC groups, with an increase in BF in the JTC group and a decrease in the no-JTC group, which, similarly to other ESM BF results, is opposite to the predicted direction.

Figure 5.10

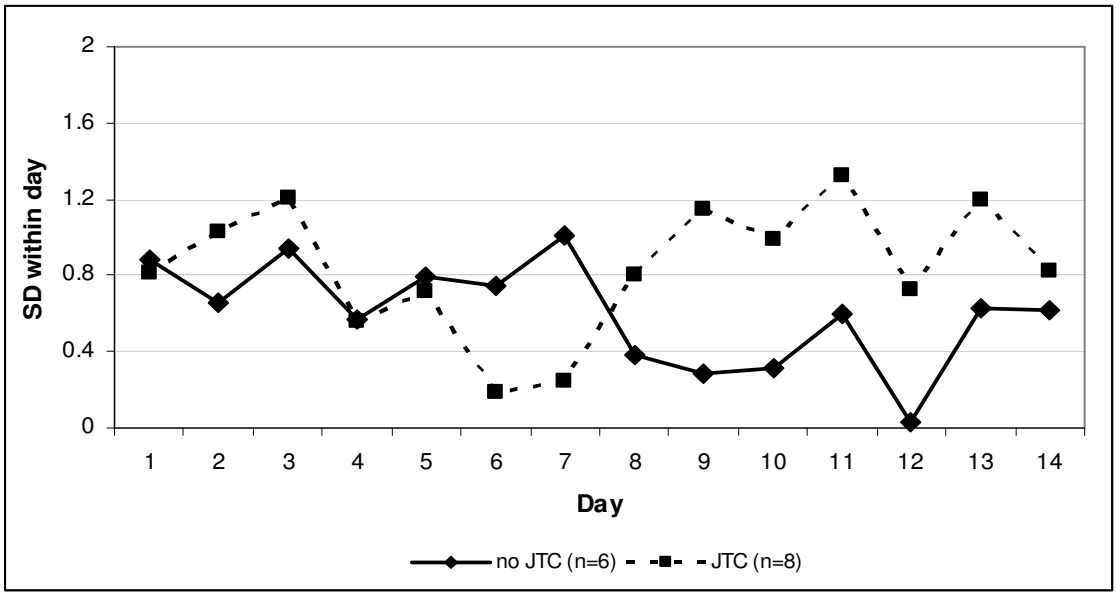
Change over time in ESM belief flexibility by baseline JTC on the 60:40 beads task (N = 14)



Within-day variability (i.e. SD) of BF in individuals who showed the JTC bias on the 60:40 beads task and those who did not is presented in Figure 5.11. The interaction between Day and JTC in predicting variability of BF was not significant (B = 0.04, SE = 0.03, $p > .10$), nor were the main effects of Day and JTC ($p > .05$).

Figure 5.11

Within-day variability (measured by SD) of ESM belief flexibility by baseline JTC on the 60:40 beads task (N = 14)



5.7 Discussion

This study investigated moment-to-moment fluctuations and changes over time in 16 acute patients as they began antipsychotic treatment. ESM variables included delusional dimensions, belief flexibility, and aberrant salience. To our knowledge, this is the first study to have measured aberrant salience and belief flexibility using ESM. It is also the first investigation of people with acute psychosis using ESM over two weeks.

We found that conducting ESM in an acute sample of in-patients with delusions was feasible, although not without challenges. Firstly, the inclusion criteria were restrictive – patients who had active delusions recruited very early on during their treatment. As some potential participants were too disturbed or disorganised to take part at that stage, recruitment was difficult and slow. Although only patients with at least a moderate level of delusions were recruited, it is possible that this sample represented patients who were relatively less severe within the target population. Secondly, out of the 26 patients who consented to the study, only 16 participants (61.5%) completed more than 30 ESM diary entries. Note that the

assessment period in this study was longer than in most ESM studies, which typically covered six days with participants completing 20 or more diaries entered into analysis (Palmier-Claus *et al.,* 2011b). Although there was no significant difference between the ESM completers and the rest of the sample in clinical measures and reasoning biases at baseline, unmeasured or other factors that differentiated the completers from the non-completers could not be ruled out, e.g. ability to use a PDA independently. Among the 16 participants who completed the minimum number of entries, compliance rate (70.7%) in this study was comparable to other studies using computerised ESM in in-patients with schizophrenia, e.g. 69% for an assessment of four times a day over a week in Granholm *et al.* (2008), and 79% for an assessment of ten times over a day in Kimhy *et al.* (2010).

We found good inter-item consistency within constructs, including new constructs such as belief flexibility and aberrant salience. Items of opposite constructs (i.e. positive and negative affect) were also associated in an expected direction, although the strength of association was weak. This indicates that participants were able to provide reliable responses to ESM questionnaires on the PDA, even though they were hospitalised for an acute psychotic episode.

However, congruence was low between ESM scores and interview ratings for psychotic symptoms and delusional dimensions at baseline. For change over two weeks, ESM and clinical ratings showed consistency for delusional dimensions but improvement in hallucinations and delusions was found only on clinical ratings, and not ESM. Discrepancies between ESM and interview-based measures had also been found in Peters *et al.* (2011) and Stone *et al.* (1993), who argued that ESM captured moment-by-moment phenomena that were not measured by retrospective measures. Similarly, in the present study, clinical ratings were more sensitive to overall change between baseline and week 2, while ESM allowed for examination of momentary changes during the two weeks. Clinical ratings require a reflection of the participant's experiences over the last week, whereas ESM represents the participant's thoughts and feelings at the time of assessment. Apart from the time frame of assessment, the fact that ESM is a self-report also makes it different from the interviewer-rated clinical scales. Therefore, a lack of congruence between measures does not necessarily indicate a lack of validity of ESM; rather, it is likely that the two approaches of assessment represent different aspects of the reality.

Unfortunately, since this study did not include another self-report measure other than ESM, this explanation of the discrepancy in findings is only speculative.

On the contrary, attention should be drawn to the discrepancy between the ESM and clinical ratings of belief flexibility (BF). Firstly, individuals grouped by their baseline BF on MADS measures were associated with ESM BF in the opposite direction (although both associations did not reach statistical significance). Secondly, the finding of an association between higher conviction and higher ESM BF was in the opposite direction from the finding using interview data of BF, in this and all previous studies (e.g. Freeman *et al.*, 2004; Garety *et al.*, 2005; see also Studies 1 and 2 of this thesis). These inverse associations raised the possibility that participants answered the BF items in the opposite direction. The items on BF and delusional dimensions were included in the same section, but the BF items were reverse scored (i.e. a higher score is better) and the dimension items were not. While the possibility that participants rated the BF items in the opposite direction can be considered, it is not strongly supported because items on positive and negative affect were also in one section but responses were reliable. Another possible reason is that BF involves evaluation of experiences and belief, but ESM is well suited for measuring momentary experiences/events but not reflective thinking (Palmier-Claus *et al.,* 2011b). It might be that the ESM items failed to capture the evaluative process of BF. In fact, the BF items not only demanded evaluative thinking, but were also the lengthiest among all the items. Even though the experimenter guided participants through each question during the practice session, it remains a possibility that the participants were confused by the complex sentences when they filled in the questionnaires on their own. However, if this were the case, the responses would have been more random and yet internal consistency among the three items was high. It is not immediately obvious which (or all) of these possibilities might have led to the unusual BF ratings, but as BF was measured using ESM for the first time, and concern is raised about the validity of the ESM measure of BF, the related findings should be interpreted with caution.

With the above considerations of measurement, key findings of this study are as follows: (i) there was a reduction in general symptomatology and delusions over two weeks of antipsychotic treatment (as measured by clinical ratings); (ii) on both clinical ratings and ESM, delusional distress and disruption improved, but

conviction and preoccupation did not; (iii) aberrant salience did not change; (iv) Reaction to hypothetical contradiction (as measured by MADS) predicted the level of and changes in conviction; and (v) JTC bias predicted both an increase over time in level and variability of conviction.

In this sample, PANSS total score and ratings of delusions and hallucinations reduced by more than 20% over two weeks. This finding, consistent with previous studies, lends support to the 'early onset hypothesis' of antipsychotic action which postulated that antipsychotic response starts within the first two weeks of treatment (Agid *et al.*, 2003; Leucht *et al.*, 2005a). However, there was no change in delusion (and an increase in hallucinations) on ESM, suggesting that patients did not perceive the symptom improvement subjectively. The discrepancy between subjective rating and observer's ratings of symptom change is of clinical relevance. Specifically, our finding implies that inquiring into patients' perception of symptom improvement is important as it may be different from the clinician's view.

However, delusional distress and disruption did improve over time, as measured by both clinical ratings and ESM. Delusional conviction and preoccupation did not improve over two weeks during antipsychotic treatment, again consistently across the two assessment methods. Although the lack of improvement in preoccupation was not expected, our finding is consistent with Mizrahi *et al.* (2006) in suggesting that conviction does not change significantly in the early phase of antipsychotic treatment.

As hypothesised, aberrant salience was associated with both delusional distress and preoccupation, but did not change over time. While this finding potentially suggests a lack of response of aberrant salience to antipsychotics at the early stage of treatment, the small sample size might have limited the significance of potential findings. More importantly, aberrant salience was assessed using ESM for the first time. Therefore, before drawing conclusions, replication of this result would be needed.

The close association between delusional conviction and BF found in previous studies using the MADS interview (Brett-Jones *et al.*, 1987; Garety *et al.*, 2005), was confirmed using similar measures. Specifically, individuals who had a

positive (i.e. flexible) response to one of the measures (RTHC) on the MADS showed a lower level of conviction (at baseline and throughout) than those who were not flexible, although individuals grouped by the PM measure of the MADS did not differ in ESM conviction. This provides some support for the Garety *et al.*'s (2005) model that BF contributes to the change in or persistence of delusional conviction. However, there was also some evidence that individuals who were less flexible on RTHC showed decreasing levels of conviction over time, while those who were flexible showed a small increase over time. Nevertheless, given that both groups had quite extreme conviction scores at baseline (2.3 in the RTHC-positive, and 5.3 in the RTHC-negative), this interaction could be explained by a regression towards the mean, whereby individuals with extreme ratings tend to score less extremely at repeated testing (Everitt, 2002). This interaction was not found for the PM measure, suggesting it is not a robust finding.

Using ESM measures of BF, analysis of time-lagged data showed that BF predicted an increase in conviction. Moreover, individuals who jumped to conclusions increased in BF over time. As discussed, the validity of the ESM BF measures is of concern, so no firm conclusions can be drawn from these results. Nonetheless, this study demonstrated the feasibility of applying temporal analysis to time-lagged data on key processes entailed in cognitive model of delusions during an acute stage of recovery.

This study found an interesting relationship between conviction and the JTC bias. The group showing JTC increased in both the level over time and within-day variability of conviction, while the non-JTC group showed the opposite pattern on both measures, even though the two groups did not differ in conviction at baseline. This supports the proposition that JTC contributes to persistence of delusions and moderates treatment response (Garety *et al.*, 2005; Menon *et al.*, 2008). More importantly, by assessing patients' delusions on a moment-by-moment basis, the present study confirmed a direct association between JTC and variability of the delusional belief per se. This is consistent with data from probabilistic tasks which showed that patients with delusions tend to jump to conclusions and to revise their certainty estimates in view of potentially disconfirming information, i.e. "mak(ing) strong judgements based on little information" (Moritz, Woodward, & Hausmann, 2006, p. 327). In their review, Garety and Freeman (1999) concluded that, as

shown in 'neutral' tasks, "people with delusions may be more ready to abandon existing hypotheses and form new ones, again on the basis of little evidence" (p. 131). The present study took one step further and found that this tendency may apply to delusional conviction as well. That is, JTC aggravated patients' tendency to shift their judgements (including about their delusion) from moment to moment, and patients who jumped to conclusions maintained a generally higher level of conviction over time than those who did not jump to conclusions. Note that grouping was based on JTC on the more conservative (60:40) version of the beads task only, and therefore a replication is needed using other JTC measures and in a larger sample. These results call for a better understanding of the mechanisms underlying JTC and the development of treatment for this bias. Recent developments in reasoning training targeting the JTC bias (Moritz *et al.*, 2011b; Ross *et al.*, 2011; Waller et al., 2011) have shown promise in remediating reasoning biases including the JTC effectively.

There are several limitations to this study. Firstly, the validity of the new ESM measures of BF and aberrant salience has not been established. Self-report measures of aberrant salience were not available for external validation. As discussed, BF responses did not appear to be random but were in an opposite direction to the interview-based ratings. These have limited the interpretability of the associated results. Secondly, the relatively small number of ESM completers restricted the kind of analysis performed. In particular, the subgroups by baseline reasoning bias had sizes smaller than n = 10 each. In relation to the issue of sample size, patients were not sub-divided based on the type of antipsychotics they were taking. Although we did not intend to compare effect of various antipsychotics on our key variables, we are aware that different medications may differ in their effect on affect (Lataster *et al.*, 2011), which may have an indirect impact on delusional dimensions. Lastly, there were dropouts and missing data, which might have further limited the statistical power of analysis. Therefore, replication of the novel findings is needed, particularly for analyses involving the new ESM measures.

Against these caveats, we conclude that this study corroborated other evidence that delusional dimensions improve within the first few weeks of antipsychotics with delusional conviction remaining least changed, that baseline

belief flexibility is associated with level of conviction, and that JTC is a predictor of treatment response.

Chapter 6

What has been learnt about change in delusions and reasoning processes, and the way forward

6.1 Summary of the studies

Change in delusions was the focus of this thesis. The central research question was not about improvement in overall level of severity of the symptom, as it has previously been widely shown that delusions improve with antipsychotic treatment. What was of particular interest was the *process* of change in delusions over time and during treatment, i.e. what aspects of a delusional experience respond to treatment? Do the psychological processes associated with delusional dimensions change, and if so, do they change together with delusional dimensions? Do reasoning biases predict change in delusions? To look at the process of change, three longitudinal studies were conducted using three separate samples of patients at different stages of recovery. All samples were patients with delusions of at least moderate severity. Participants in Studies 1 and 3 were in an acute stage of psychosis, with Study 3 participants having received antipsychotic treatment for less than two weeks, and Study 1 participants less than four weeks. 68.7% of Study 3 participants and 65.0% of Study 1 participants were in their first episode of psychosis, whereas Study 2 participants were patients with longer-term conditions, and a recent relapse of psychosis. The studies captured different trajectories through the disorder, with Studies 1 and 3 covering the early phase of antipsychotic treatment for eight and two weeks respectively, and Study 2 following patients over one year during a more stable stage. Sample sizes in Studies 1 (N = 40) and 2 (N = 273) were relatively large among studies of the same kind.

Within a framework of delusions as psychological phenomena, a range of measures were employed in order to achieve a fine-grained assessment of their change over time. Symptom rating scales were included to examine changes in the severity of symptomatology. However, the focus of interest was multi-dimensionality of delusions, which was measured by interviews and self-reports. These measures were chosen because (i) they assessed various dimensions of delusions which had been shown to change independently over time and with treatment; and (ii) the questions were individually designed so that the specific wording corresponded to the idiosyncratic content of patients' delusions. These measures, therefore, allowed for sensitive assessment of the same delusional belief for each individual across time points. This was especially important in the early phase of treatment, e.g. Study 1, when drastic changes in phenomenology were

expected. When the process of change during the acute phase of treatment was concerned, i.e. Study 3, a still more sensitive assessment was demanded. We adopted the experience sampling method (ESM), a structured diary of moment-to-moment psychological experiences in the flow of daily life. ESM has been used in studies of psychiatric disorders including schizophrenia, but this was the first time it has been used to assess multi-dimensional delusional changes over two weeks in an acute sample of patients who had only just begun medication. Using ESM, Study 3 explored whether acute patients were able to give reliable 'on-line' reports of their symptoms and delusional experiences, how delusional dimensions changed over two weeks of treatment, and whether reasoning biases predicted momentary level and within-day fluctuations of delusional conviction.

Apart from delusional changes, another key aim of the thesis was to investigate the prospective relationship between delusional dimensions and psychological processes over time and during treatment. Mood changes were examined in Study 1, using validated questionnaires. Two reasoning processes were examined in all studies – the 'jumping to conclusions' (JTC) bias and belief flexibility (BF), as they have been proposed to be closely associated with the development and maintenance of delusions (see review in Chapter 2). Using multiple measures of JTC, BF and delusional conviction, Study 2 established the factor structure of these constructs, as well as their relationship over time. Study 1 examined early response of JTC and BF to antipsychotics over eight weeks in an acute sample. Based on the results of the literature review (Chapter 2) and Study 1, which suggested that BF was more likely to change (than JTC) during improvement in delusions, we explored the use of ESM to capture within-day changes in BF in a shorter time frame of two weeks. As well as BF, new ESM measures were also devised for aberrant salience in Study 3, and its proposed relationship with the emotional aspects of delusions (i.e. distress and preoccupation) was tested.

In summary, this thesis consists of three empirical studies examining the process of change in delusional dimensions over periods ranging from two weeks to 12 months, as well as their relationship with psychological processes such as reasoning and aberrant salience.

6.2 Summary of results

Key findings of the studies are summarised in Table 6.1.

Table 6.1

Summary of findings of all studies

	Study 1 (N=40): 8 weeks	**Study 2 (N=273): 12 months**	**Study 3 (N=16): 2 weeks**
Overall change in symptom severity	Delusion improved on PANSS	Delusion improved on PANSS and SAPS	Delusion improved on PANSS and SAPS
Change in delusional dimensions	All dimensions improved Dimensions correlated with each other	Conviction improved over first three months	Distress and disruption improved, conviction and preoccupation did not
Change in JTC & BF	PM (but not RTHC) improved JTC did not change Cognitive biases reduced Appraisals of anomalous event improved	BF factor did not change JTC factor did not change	
Relationship between conviction & BF	Higher BF was associated with lower conviction Baseline BF did not predict change in conviction	Higher BF associated with lower conviction Baseline BF predicted conviction change (0-3 months) at trend level	Higher BF (on MADS RTHC) associated with lower conviction ESM BF associated with conviction in the opposite direction

Relationship between delusions and JTC	JTC was not associated with level of conviction Baseline JTC did not predict change in conviction	No correlation between JTC factor and conviction factor Baseline JTC did not predict change in conviction Patients with delusions had increased JTC than patients without delusions at two of the three time points	Individuals who did not JTC decreased in level and variability of conviction over time (while those who showed JTC increased)
Relationship between JTC & BF		Weak association at baseline only	Individuals who JTC increased in level of ESM BF
Relationship between delusions, mood and aberrant salience	Preoccupation co-varied with depression and anxiety Other dimensions co-varied with subjective distress		Distress and preoccupation associated with aberrant salience cross-sectionally and over time
Change in mood and aberrant salience	Trend improvement in anxiety Depression and subjective distress did not change (measured by multi-level modelling)		Aberrant salience did not change

As set out at the beginning of this chapter, the aim of this thesis was to investigate the process of change over time and during treatment. We confirmed that there was indeed a change, i.e. symptom improvement, in our samples. In all three studies, there was a reduction in severity of delusions and overall symptomatology over the study periods. Therefore, our samples were examined during the course of recovery. When we examined changes in delusional dimensions, the picture was less consistent. Distress and disruption improved over two weeks in Study 3 on both interview-based and self-report measures. Conviction and preoccupation did not improve. However, all four dimensions improved together over eight weeks in Study 1, and marked reduction was evident in the first two weeks. Our hypothesis that aberrant salience would be associated with delusional distress and preoccupation was supported, and this relationship grew stronger over time. However, the lack of change in aberrant salience was unexpected.

We investigated the role of BF and JTC in the development and maintenance of delusional dimensions across studies using multiple measures. As hypothesised, individuals with higher BF had a lower level of conviction (across studies), although there was mixed evidence as to whether baseline BF predicted change in conviction. However, the association between BF and conviction was in the opposite direction when BF was measured using ESM, and the validity of these specific items was questioned. In contrast, JTC was not associated with conviction and did not predict conviction change in Studies 1 and 2, but individuals who showed JTC increased in the level and variability of conviction over time.

6.3 Theoretical implications

6.3.1 Differential response of delusional dimensions to antipsychotics?

One of the hypotheses in Studies 1 and 3 was that the various delusional dimensions would respond to the early stage of antipsychotics differently. Study 1 aimed to replicate Mizrahi *et al.*'s (2008) finding that preoccupation and distress responded to early antipsychotic treatment faster and to a greater extent than

conviction. Using a sample that doubled the size of that in Mizrahi *et al.* (2008), Study 1 compared relative changes in all dimensions using linear mixed modelling. The hypothesis that the affective aspects (i.e. distress and preoccupation) would improve faster than conviction was not supported. All dimensions improved over eight weeks, and conviction did not change differently from other dimensions. In fact, there was a strong correlation between dimensions across time points. In contrast, in Study 3 distress and disruption improved over the first two weeks of antipsychotic medication, but conviction and preoccupation did not. Therefore, these findings suggest that delusional dimensions did respond to antipsychotics differentially in Study 3, but not in Study 1. The results remained discrepant between the two studies when delusional change was examined over a comparable period of time. Over the first two weeks of treatment, all dimensions (including conviction) showed marked reduction in Study 1 (see Figures 3.1, A.1, A.2). On the other hand, conviction remained largely unchanged over two weeks in Study 3.

The following possible explanations of the inconsistent results have been considered. Firstly, the Study 1 sample had higher ratings on all dimensions at baseline (see Table A.1) than the Study 3 sample (see Table 5.3), hence having more potential for improvement over time. Secondly, the Study 3 sample had a shorter duration of treatment, suggesting a possibility that a differential response to treatment among dimensions occurs only in a very early phase of treatment. In Mizrahi *et al.* (2006) where a differential response was reported, the participants were drug free (or had started antipsychotics within last 48 hours). The Study 3 sample, although not completely drug-free, was more comparable to Mizrahi *et al.*'s (2006) than the Study 1 sample, but delusional change was not measured beyond two weeks, and the sample size was small. However, measures in Studies 1 and 3 were superior to Mizrahi *et al.* (2006) for examining treatment response of delusional dimensions because delusions (rather than 'principal psychotic experiences') were measured specifically and our conviction measure did not include an element of insight. Therefore, what is needed is another longitudinal study assessing drug-free patients of a good sample size using robust measures of delusional dimensions.

6.3.2 What does symptom improvement on clinical rating scales mean?

Symptom ratings and multi-dimensional ratings revealed a rather different picture of the process of recovery. There was a significant reduction in delusions and general symptomatology on symptom rating scales in both Studies 1 and 3. However, conviction improved in Study 1 only. It was distress and disruption that improved in Study 3, suggesting that clinical ratings were largely affected by these affective dimensions of delusions. This is intriguing because conviction is central in the definition of delusion (American Psychiatric Association, 2000; Appelbaum *et al.,* 2004; Harrow *et al.,* 1988; Kendler *et al.,* 1983), and guidance of delusion ratings on PANSS and SAPS does operationalise severity of the symptom based on various dimensions including conviction, distress and disruption, etc. However, delusions were rated as reduced even though the strength of the belief (i.e. conviction) remained high, suggesting that multi-dimensional assessment of delusional experiences provided additional and important information about recovery which was not represented in clinical ratings. Therefore, it is recommended that assessment of dimensions is included in treatment outcome evaluation and clinical practice.

6.3.3 Aberrant salience was associated with delusional dimensions but did not change with antipsychotics

Study 3 investigated change in aberrant salience according to Kapur's (2003; Kapur *et al.,* 2005, 2006) notion of the construct, and hypothesised that aberrant salience would be associated with delusional distress and preoccupation over two weeks of treatment as measured by ESM. Three ESM items were developed to assess this construct, with acceptable internal consistency. However, the measures were not validated against any external assessment of aberrant salience. This was a problem because the concept itself has been rather loosely defined. Aberrant salience in schizophrenia had been reported using the Salience Attribution Task (SAT; Roiser *et al.,* 2009) and the Aberrant Salience Inventory (ASI; Cicero, Kerns & McCarthy, 2010). However, the SAT provides behavioural indices of adaptive

and aberrant salience based on goal-directed behaviour, and the ASI measures "lifetime occurrence or trait aberrant salience that can be used in non-clinical samples". Therefore, both measures were not suitable for the purpose of this study, and were not directly comparable to the ESM measures, which focused on subjective feelings of novelty, attention grabbing, and exaggerated importance at the moment of assessment.

Using ESM, the hypothesis of an association between aberrant salience and delusional distress and preoccupation was confirmed, with these associations becoming stronger over time. This is consistent with Kapur and Mamo's (2003) proposition that aberrant salient experiences are distressing. However, the finding that aberrant salience did not improve over two weeks of antipsychotic treatment, unlike distress, was not expected. One possible interpretation of this finding is that aberrant salience did not respond to antipsychotics because the treatment was not optimal, as indicated by a lack of change in delusional preoccupation. Another interpretation is that there was a change in aberrant salience but the change was not captured by the measures. Bearing in mind that the measurement of aberrant salience used ESM only, and for the first time, and was not validated against other measures, it is not clear how valid or sensitive this measure is to change in aberrant salience. While Study 3 had demonstrated the feasibility of obtaining subjective reports of aberrant salience as experienced through ESM, future work is needed to further develop the assessment measure, specify its validity and reliability, and examine aberrant salience in individuals across stages during the course of illness, from prodrome, to acute stage, to remission.

6.3.4 Relationship between BF and the strength of delusions

Three questions were addressed about BF and conviction: (i) how was BF related to level of conviction? (ii) did BF improve with antipsychotics? (iii) did having better BF predict better treatment response in conviction? Various measures were used to approach these issues, including the MADS items – Possibility of being Mistaken (PM) and Reaction to Hypothetical Contradiction (RTHC) in all studies, and an additional Generation of Alternative Explanations (AE) item from the EoE interview in Study 2. Analysis of BF was based on responses to individual

items in Studies 1 and 3, and as a factor in Study 2. Strong evidence was found for an association between higher BF and a lower level of conviction cross-sectionally, with the only exception in Study 3, where level of conviction was not significantly associated with PM. Therefore, we have corroborated previous evidence (e.g. Freeman *et al.,* 2004; Colbert *et al.,* 2010) that BF is closely related to the strength of conviction. Study 2 tackled this conceptual issue: if BF is so strongly associated with conviction, could it simply be another way of measuring conviction? Using a large sample (N = 273) of patients with delusions in current relapse of psychosis, factor analysis found that BF, JTC, and conviction are three separable factors. BF was not simply an indirect representation of conviction, although it was consistently related to conviction. Therefore, measuring BF as a separate construct to conviction is conceptually meaningful and important, and the way one evaluates one's delusional belief is consistently associated with the strength of that belief.

So which way does the relationship go? Does being flexible reduce conviction, or does weak conviction make one more likely to evaluate one's belief flexibly? This is an important question because understanding the directionality of the association will bring us closer to the mechanism of belief maintenance and to developing effective treatment strategies. The best approach to test the directionality of a relationship is to intervene on one aspect in randomised conditions and examine changes in the other aspect. This had recently been done in studies of reasoning training (e.g. Ross *et al.,* 2011; Waller *et al.,* 2011), which provides preliminary evidence that intervening with BF leads to conviction change. Rather than testing directionality of the relationship experimentally, Study 3 attempted to examine the temporal relationship between BF and conviction using time-lagged data. In this study, BF at one moment predicted an increase in conviction at the next assessment moment within the same day, but not the other way round. While this might potentially indicate a link from BF to conviction, the fact that higher flexibility actually predicted an increase in conviction was not as hypothesised and was in the opposite direction to all previous published findings using MADS. Therefore, on the basis of questionable validity of the ESM measures of BF (which will be further discussed in section 6.3.7), both the short term prediction of change and the directionality of the association between BF and conviction remains an open question.

Since BF was closely related to the strength of belief, it was expected that BF would also change as conviction improved with treatment. Findings of a change in BF were mixed. In Study 3, where there was no change in conviction, BF did not change over two weeks on either MADS or ESM. In Study 1, where conviction declined over eight weeks, patients became more likely to consider the possibility of being mistaken (PM) about their delusion. However, even though the proportion of patients who were flexible on PM doubled from 30% at baseline to 60% at week 8, a substantial 40% still did not consider the possibility of being mistaken about their delusion. In addition, almost half of the patients responded inflexibly when confronted with a hypothetical scenario that was incompatible with their belief, and this did not improve with antipsychotics. These rates were comparable to the stable sample in Study 2. Therefore, although some patients began to evaluate their delusional belief more flexibly over eight weeks of antipsychotics, a substantial proportion of patients remained inflexible.

Did a lack of BF maintain level of conviction over time and during treatment? Over 12 months in Study 2, baseline BF predicted an improvement in conviction in the first three months, though at trend level only. Note, however, that change in conviction in this study was modest. During treatment in the acute phase of psychosis (Studies 1 & 3), baseline BF did not predict changes in conviction. This should be interpreted against the caveat that there was no conviction change in Study 3, and that baseline conviction differed between the flexible and inflexible individuals, potentially limiting the room for further improvement in conviction in the flexible group.

In summary, higher BF was consistently associated with a lower level of conviction. BF began to improve over eight weeks of antipsychotics, but the improvement was incomplete and approximately half of patients remained inflexible. Garety *et al.* (2005) proposed that higher BF would moderate conviction change. Our results did not consistently support this, although a modest change in conviction in our samples might have limited the power to investigate moderation of change.

6.3.5 Stability and prevalence of JTC

The three studies in this thesis have extended our understanding of stability and prevalence of JTC in individuals with delusions. JTC was relatively stable over 12 months in Study 2, and during the acute and early stage of antipsychotic treatment in Study 1. This is consistent with previous reports, for example, Peters and Garety (2006) of patients in a recovery phase, and Ormrod *et al.* (2012) of patients with first episode psychosis. These findings support the stability of JTC within the study periods. Note that different stages of recovery were examined in separate studies, so how JTC might change from the acute phase to the recovery phase of illness was not directly investigated.

When JTC across phases of illness was compared, data suggest a possible exacerbation of the reasoning bias in acute psychosis. The tendency of JTC (i.e. making a decision after viewing two beads or fewer) was stronger in the acute phase (Studies 1 & 3) than in the recovery phase (Study 2). In Study 2, the prevalence rate of JTC was around 40-60%, which was comparable with previous studies of individuals with delusions (see reviews by Fine *et al.*, 2007; Freeman, 2007; Garety *et al.*, 2007). In Studies 1 and 3, the JTC rates were a lot higher – 77% (Study 1) and 65% (Study 3) on the 60:40 task, and 76% on the 85:15 task (Study 3). 50-70% of the sample made a decision after only one bead. The number of beads drawn to decision (2.67 (Study 1) and 3.96 (Study 3) on the 60:40 task, and 2.68 (Study 3) on the 85:15 task) was comparable or greater than some studies of patients with delusions (e.g. Fear & Healy, 1997; Huq *et al.,* 1988; Moritz & Woodward, 2005; Warman *et al.,* 2007), but less than others (e.g. Dudley *et al.,* 2011; Lincoln *et al.,* 2010; Peters & Garety, 2006; Peters *et al.,* 2008).

Two possible explanations for the discrepancy in JTC rates may apply. Assessment of JTC was conducted by the same researcher in Studies 1 and 3, which was different from Study 2. Although the same computerised task was delivered with the same instructions given, subtle differences in the way instructions were given cannot be entirely ruled out. However, a more likely explanation for the discrepancy lies in the difference in the stage of illness. In most studies that reported JTC in patients with delusions (e.g. Garety *et al.,* 2005; Menon *et al.,* 2008; Moritz & Woodward, 2005), patients were assessed when they had been stabilised with medication. The only exception is Menon *et al.* (2008) in which more than

half of the sample were drug-free when assessed. However, only less than one-third of Menon *et al's* (2008) sample were in-patients and recruitment was not restricted by severity of delusions. When only patients with active delusions (with a PANSS delusion score of 3 or above) were included, Warman *et al.* (2007) reported a prevalence of JTC as high as 80% on both the neutral and self-referent versions of the beads task. Studies 1 and 3 included only patients who had active delusions of at least a moderate level of severity, and who had not, or just started, antipsychotic treatment. Therefore, the Study 1 and 3 samples were closer to Warman *et al*'s (2007), and together these findings suggest that JTC is more pronounced in patients with acute delusions (see also Brankovic & Paunovic, 1999; Startup *et al.*, 2008).

Was JTC more prevalent in the acute phase because of impulsiveness or poor understanding of the task (Balzan *et al.,* 2011)? This was not likely because (i) participants drew more beads in the harder version of the task (60:40) than in the easier version (85:15) when both versions were used in Study 3, and (ii) there were no more errors in the JTC group than the non-JTC group. There has been a debate on whether JTC bias is attributable to neurocognitive deficits such as working memory, but the data so far are inconsistent (e.g., Broome *et al,* 2007; Dudley *et al.*, 1997a; Menon *et al.,* 2006; Ormrod *et al.*, 2012). A memory aid (cf. Dudley *et al.,* 1997a) was included in both Studies 1 and 3, so memory demands of the task were minimised.

In summary, the three studies in this thesis did not find a change in JTC over time and with treatment, but there was more JTC in the acute phase than in the recovery phase, which potentially suggests that JTC might improve across phases. This is a hypothesis which can be tested when JTC is measured from the acute stage of illness through to the stabilised stage.

6.3.6 JTC and divergent change in conviction

Garety *et al.*'s (2005) proposal that JTC would be associated with level of conviction and its response to treatment was tested in all three studies. Contrary to Garety *et al*'s (2005) model, JTC was not associated with level of conviction cross-sectionally in any of the studies. This suggests that JTC is not closely related to delusional conviction, and Study 2 instead suggested that it was related to presence

or absence of delusions. Findings were mixed regarding prediction of conviction change. JTC did not predict change in conviction in Studies 1 and 2. As discussed, the overall change in conviction was small in Study 2, hence limiting the power of this study to investigate moderation effects.

On the other hand, when the momentary level of conviction was measured using ESM, and change was assessed from the initiation of antipsychotic treatment, very early in an acute episode, a potential role of JTC in affecting treatment response was found in Study 3. ESM encompassed multiple assessment points within a day, and across days, thus measuring more observations than the interviews. While baseline level of conviction did not differ between individuals who showed the JTC bias and those who did not, conviction declined during treatment in the non-JTC group, but increased in the JTC group, suggesting that only the non-JTC group responded to antipsychotics. Therefore, in this study JTC contributed to the maintenance of conviction and moderated treatment response. This is a novel finding, and suggests that effective treatment for JTC may strengthen patients' response to antipsychotics.

The non-JTC group decreased not only in the level of conviction, but also in the variability of conviction during antipsychotic treatment, while the JTC-group maintained a high variability of conviction. This finding is in line with Moritz *et al*'s. (2006) and Garety and Freeman's (1999) suggestion that people with delusions tend to revise their certainty estimates or abandon their hypotheses based on little evidence. Study 3 demonstrated that patients did revise their judgement of their delusional belief within a day (see also Peters *et al.,* 2011), and that this tendency to revise their judgement was enhanced by JTC. As individuals who showed a JTC tendency made judgements based on limited evidence, they changed their judgement about their belief relatively easily based on new (again limited) evidence, possibly in response to what was happening at the moment, leading to unstable appraisals. It is possible that as individuals kept changing their appraisals over time, preoccupation of the delusions was also maintained. Study 3 reported a lack of change in preoccupation over two weeks, but the potential link between JTC, variability of conviction and the maintenance of preoccupation is a hypothesis to be tested with future research.

It is of interest to speculate how the JTC effects on level of conviction and variability of conviction might be inter-related. Rather than arriving at one conclusion and holding onto it consistently, patients might abandon a delusional idea at one moment but then become certain about it again at the next; hence maintaining a high overall level of conviction and limiting response to antipsychotic treatment. This is consistent with Garety *et al.*'s (1991) proposal that a lack of influence of stored regularities on current input (Hemsley, 1987, 1993) underlies the JTC effect, but this suggestion was not explicitly tested in Study 3. While Study 3 reported an interesting relationship between JTC and maintenance of conviction with treatment, this was a novel finding which requires replication, and individuals were grouped by JTC on the 60:40 version of the beads task only. Future research will be needed to test the hypothesised link between JTC, variability of conviction and maintenance of delusions.

In summary, it seems that BF and JTC contribute to the aetiology of delusions differently. BF is closely related to the state of delusion, with higher flexibility strongly associated with lower conviction. It responded partially to antipsychotics as conviction improved, but did not predict treatment response of conviction. In contrast, JTC was not associated with level of conviction. It did not change over time or with antipsychotic treatment (although it might change from the acute to the stable phases). There was preliminary evidence suggesting a role of JTC in maintaining delusions potentially via limited data gathering and a lack of influence of stored regularities, which causes both fluctuations and persisting conviction. JTC is also specific to delusions, rather than being a general characteristic of psychosis, as supported by the difference in JTC between patients with and without delusions. Different processes are involved in JTC and BF, as a weak association was found between the two constructs in the factor analysis in Study 2. Moritz *et al.* (2010a) also reported JTC and inflexibility as separate factors and argued for them to be treated independently.

6.3.7 Use of ESM in acute patients with delusions over two weeks

The use of the experience sampling method (ESM; Csikszentmihalyi & Larson, 1987; Myin-Germeys *et al.,* 2009) in Study 3 was innovative in a number of ways. Firstly, the duration of 14 consecutive days was one of the longest periods among the published ESM studies. Secondly, while ESM had been used in patients with psychosis (including delusions) before (e.g. Myin-Germeys *et al.,* 2001; Palmier-Claus *et al.,* 2011a), it was the first time that patients in an acute stage of psychosis who had not been stabilised with medication were assessed using this method. Thirdly, new constructs, namely BF and aberrant salience, were included. This section reflects on the use of this methodology in this particular group of patients and suggests further development.

Recruitment for Study 3 was a challenge. Among 68 suitable patients who were invited to take part in the study, 26 consented to take part, resulting in a total consent rate of 38%. While Studies 1 and 3 shared the same sites of recruitment, with similar inclusion criteria (except for a shorter duration of treatment in Study 3), the consent rate was higher (51.3%) in Study 1. Over a two-week period, two out of 40 patients (5.0%) in Study 1 dropped out, but eight out of 26 patients (30.8%) dropped out in Study 3. It was likely that engagement was more challenging in Study 3 because participants had been on treatment for a shorter period of time than were the Study 1 sample and were approached during a turbulent time, having just been admitted on the ward. But it was also likely that the relative difficulty with recruitment for the ESM study was related to the demands of the self-assessment. Individuals were required to use the personal digital assistant (PDA) independently, to keep the PDA with them at all times, to respond to the signals quickly, and to charge the battery when necessary. Apart from reasons for refusal that were similar between the two studies, some patients refused to take part in Study 3 because they did not think they could manage the assessment on their own, or keep the PDA safe in the ward environment where they had no guarantee over security.

One related issue was the pros and cons of using computerised format of ESM. Two PDAs were lost during the study, and one was damaged. Granholm *et al.* (2008) also reported loss of a PDA. Therefore, the costs incurred on replacing

the PDAs should be considered when planning for this kind of study. On the other hand, ESM studies using paper-and-pencil format also require participants to carry with them a wristwatch that signals assessment times, and there are also reports that these wristwatches go missing (Palmier-Claus, personal communication). Another problem that arose was flaws or bugs in the software. There were a few occasions where the data collected from the PDA were in a strange format or simply missing. Specialist technical support was required to recover the data. Although there were difficulties in relation to the use of an electronic device and computer software, the paper-and-pencil format was not without problems either, and on the whole the advantages of computerised ESM over paper-and-pencil format (e.g. time-stamped data, no backfilling of reports, automatic data entry, etc.), are considered to have outweighed the difficulties.

For the individuals who did take part in the ESM study, the assessment was considered acceptable. Completion rates of self-reports was comparable with other studies with in-patients diagnosed with schizophrenia (e.g. Granholm *et al.,* 2008; Kimhy *et al.,* 2010). A few patients commented that the assessment was enjoyable because it gave them "something to do", made them "less bored", and helped them "understand (their) feelings better". The high internal consistency among items of the same construct suggested that patients in an acute stage of psychosis were able to enter valid 'online' reporting of subjective experiences in an electronic device without the presence of a researcher. Therefore, this study showed feasibility of obtaining internally consistent self-reports from acute patients of psychosis using ESM.

The next question was whether ESM provided additional information about change that was not already represented by interview-based measures. Change between interview-based measures and ESM measures was consistent for delusional dimensions, but not for severity of psychotic symptoms. One possible explanation was that the external validity of ESM was better for delusional dimensions than for psychotic symptoms. However, this explanation was not supported by the fact that measures were partially consistent for psychotic symptoms but not consistent for delusional dimensions at baseline. In other words, for delusional dimensions, ESM and clinical ratings were not associated at baseline, but both measures showed similar changes with treatment. For psychotic symptoms, baseline measures were

partially consistent, but only clinical ratings showed an improvement over two weeks. Therefore, it was more likely that ESM and clinical ratings represented different processes of change. As discussed by Peters *et al.* (2011) and Stone *et al.* (1993), ESM captured moment-by-moment phenomena that were not measured by retrospective measures. When ESM measures across a week were analysed collectively, Granholm *et al.* (2008) reported a strong association between ESM (across the week) and baseline PANSS scores of psychotic symptoms among community-dwelling patients with schizophrenia. Note that Granholm *et al.* (2008) compared baseline clinical ratings with ESM data across the whole week, whereas Study 3 compared baseline clinical ratings with ESM data on the same day. We did not compare the baseline symptom rating scales with ESM in the whole week, because rapid change with treatment was expected in our sample, and it was the change that was of interest. However, the difference between Study 3 and Granholm *et al.* (2008) supports the view that clinical ratings represented the overall (or averaged) level of severity, while ESM measures represented the level at the moment which could fluctuate within and between days. Palmier-Claus *et al.* (2011b) also reported that "an assumption of ESM is that response will vary over time" and the value of ESM was to determine if a variable was "trait-like (i.e. showing minimal variation across time and situations) or state-like (showing large variation in responses over time and situations)" (p. 16). We took advantage of this feature of ESM and investigated not only whether conviction and BF were state-like, but also whether JTC trait predicted variation in the state-like constructs. This kind of analysis could not be done with clinical ratings alone.

The ESM measures of BF in Study 3 were problematic. ESM responses on these items did not seem to be random; rather, they were consistently in the opposite direction from the interview ratings and the expected association with conviction. It is speculated that participants might have problems with these specific items because (i) they were the only inverse scored items within the same section; (ii) they involved reflective thinking which was not sensitively measured by ESM; and (iii) the questions were wordy with a complex sentence structure. Future research will be needed to clarify these issues.

ESM differed from clinical ratings on (i) being an assessment of momentary experiences (and not retrospective), and (ii) being a self-report measure. It was not

clear to what extent the discrepancy in findings about change between measures was related to (i) or (ii), or both. This question could be tested in future studies using both ESM and other self-report measures.

6.4 Limitations

This thesis addressed two main questions: (i) how delusions change over time and with treatment, and (ii) whether reasoning biases predict delusional change. In relation to the first question, a limitation of Studies 1 and 3 was that not all participants were antipsychotic-naïve when assessed, and Study 2 recruited patients with established psychotic illnesses, who were all already medicated. While in Studies 1 and 3 the researcher approached the participants as early as possible, a delay of recruitment occurred in some cases, due to patients' request or the advice of ward staff to wait for a few days. Moreover, in order to facilitate recruitment, we did not limit inclusion to patients with a first episode psychosis. We are aware that patients who have received antipsychotics before may respond differently to those who are new to the treatment. Specific limitations of the ESM methodology were discussed at length in Section 6.3.7 and in Chapter 5. Most importantly, the measures of BF were questionable and need to be further developed. In addition, since numerous comparisons were included and some of the questions had not been tested before, replication of the ESM results are needed.

Other limitations are related to the second question, i.e. moderation of change. Firstly, only a small change in conviction over time was reported in Study 2. Secondly, an unusually high rate of JTC was reported in Studies 1 and 3. These limited the effectiveness of examining group difference on changes over time. Thirdly, the power of the analyses was limited by small group sizes when individuals were compared based on reasoning biases, especially in Study 3.

Other limitations concern the overall design of the studies. Firstly, patients with various subtypes of delusions were analysed as a group. The studies did not set out to test the treatment response or association with reasoning biases between various subtypes of delusions. There is evidence that various subtypes bear differential relationships with attributional style (e.g. Jolley *et al.,* 2006), and very recently there are reports of a differential relationship between delusion subtypes

and JTC and BF (Garety *et al.,* in press; Menon, Addington, & Remington, 2011). Secondly, this thesis consisted of longitudinal studies covering either the early stage of treatment or the stable stage. The patients were not examined from one stage to another continuously. Stability of constructs for the longer-term could only be inferred from the difference between the acute and recovery stages. For example, JTC was more severe in the acute stage than in the recovery stage, so it is possible that JTC might improve if the same patients are followed for long enough. However, this remains a hypothesis to be tested.

6.5 Clinical implications and future research

Studies 1 and 3 confirmed that delusions improved with antipsychotics, but the improvement was not complete. These studies also shed some light on how psychological processes (including reasoning biases, aberrant salience and affect) relate to delusions over time, respond to treatment, and moderate treatment response. These findings carry important clinical implications as they will help to identify processes that are likely to lead to improved treatment outcome.

Most importantly, this thesis confirmed previous findings (e.g. Garety *et al.,* 2005; see Chapter 2 for literature review) that delusions are closely related to BF and JTC, and further specified their relationships in three longitudinal samples during different trajectories of recovery. BF was consistently found to be associated with a lower level of conviction. There was a hint that BF predicted treatment outcome (see Brett-Jones *et al.,* 1987) in Study 2 only, but no moderation effect was found in the acute phase. JTC was not closely associated with conviction or BF, suggesting that JTC is not a marker of conviction. However, it is elevated in the acute phase (as reported in Studies 1 and 3; Menon *et al.,* 2008; Warman & Martin, 2006). It is relatively stable within studies, but might change between phases. JTC appears to be a predisposing factor to the development of delusions (as reported in Study 2; Van Dael et al., 2006) and might potentially contribute to the maintenance of conviction (Study 3). Therefore, these findings suggest that effective treatment of both BF and JTC will be of benefit to improvement in delusions.

The routine psychiatric interventions for psychosis did not remediate these reasoning biases adequately. JTC did not respond to antipsychotics, and BF only responded partially. Recent development of more focused interventions for reasoning processes has shown support for changing delusions via modifying reasoning. Moritz and Woodward (2007) designed a four-week metacognitive training (MCT) approach, targeting a range of reasoning biases, including attributional style, JTC, liberal acceptance, bias against disconfirmatory evidence, need for closure, overconfidence in errors, and theory of mind. Moritz *et al.* (2011c) combined MCT with an individualised cognitive-behavioural therapy-oriented approach (MCT+) and reported a greater improvement in both delusions (including conviction) and JTC following MCT+ than active control. Ross *et al.* (2011) administered a single-session computerised reasoning training (including some tasks from the MCT) to patients with delusions. The tasks targeted JTC and BF. They found an improvement in data gathering following the session, and some small though non-significant changes in BF and conviction. They then extended the reasoning training into the Maudsley Review Training Programme (Waller *et al.,* 2011), with the addition of real-life scenarios and delusion-relevant material in the exercises. They found an improvement in JTC, BF and delusional conviction in patients with high levels of conviction. Therefore, early evidence has shown that reasoning training can reduce JTC and BF in patients with high levels of conviction, and also lead to changes in conviction, in the short term. Future research will be needed to examine the effectiveness of reasoning training on JTC and BF and delusional conviction in the longer term, as a stand alone treatment or an adjunctive treatment with cognitive behavioural therapy for delusions. In addition, there has been an increase in interest in looking for the mechanism underlying the JTC phenomenon (see reviews by Fine *et al.,* 2007; Lincoln *et al.,* 2010). Study 3 found that JTC predicted the level and variability of conviction during treatment. Future research could further investigate this role of JTC, and whether variability in the acute phases is involved in the maintenance of delusions. It will also be of interest to see if reasoning training will reduce variability of conviction as JTC improves.

The use of ESM to measure moment-by-moment fluctuations of aberrant salience and belief flexibility needs further investigation. If validity of the measures is improved, ESM is a potentially valuable method for delineating the

direction of the relationship between conviction and BF, and for examining change in aberrant salience over time and during treatment.

6.6 Concluding remarks

This thesis consisted of a programmatic investigation of psychological changes in delusions over time and with treatment, using detailed assessments of delusions and reasoning biases, during various phases of recovery. Some findings in this thesis are consistent with previous studies, for example, that JTC and BF are associated with delusions, and that delusions consisted of multiple dimensions which relate to other psychological processes and respond to treatment differentially. Some findings are new, for example, the factor structure of BF, JTC and conviction, the feasibility of assessing changes in delusions and associated psychological processes using ESM, and the potential relationship between JTC and the level and variability of conviction during treatment. It is hoped that this thesis has taken one step further towards our understanding of the psychology of delusions during the recovery process, and will inform future research in psychological model and treatment for delusions.

* * * * *

Delusions are complex psychological phenomena, which are part of the complex illness of psychosis. The endeavour to understand delusions and psychosis is in some way not dissimilar to the old story of "the blind men and the elephant": four blind men try to understand what an elephant looks like by touch. One, grabbing a tooth, says an elephant is like a thick radish. The other one, touching the ear, says it is a palm-leaf fan. The third man, clutching a leg, says an elephant is a big pillar, and the fourth man pulls the tail and says an elephant is just a straw rope. While this thesis has examined delusions from a cognitive/ reasoning approach, other ways of understanding this symptom and illness are possible. Perhaps if we walk around the 'elephant' and consider alternative views, rather than jumping to conclusions based on insufficient data gathering, we will all gain a fuller understanding of the phenomena.

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Appendix 1

Ethical approval

Study 1

NHS
National Research Ethics Service

Camden & Islington Community Local Research Ethics Committee
Room 3/14
Third Floor, West Wing
St Pancras Hospital
4 St Pancras Way
London
NW1 0PE

Telephone: 020 7530 3799
Facsimile: 020 7530 3931

06 October 2008

Ms Suzanne Ho-wai So
Research Psychologist
Institute of Psychiatry
Department of Psychology PO Box 78
Addiction Sciences Building
4 Windsor Walk
London
SE5 8AF

Dear Ms. So

Full title of study: **Psychological response to antipsychotic medication**

REC reference number: **08/H0722/76**

The Research Ethics Committee reviewed the above application at the meeting held on 29 September 2008. Thank you for attending to discuss the study.

Documents reviewed

The documents reviewed at the meeting were:

Document	*Version*	*Date*
Participant Consent Form	Version 1	07 August 2008
Participant Information Sheet	Version 1	07 August 2008
Questionnaire: M.A.D.S		
Questionnaire: Delusions		
Questionnaire: Auditory Hallucinations		
Questionnaire: Clinical Global Impressions		
Questionnaire: Appendix C: Positive and Negative Syndrome Scale (PANSS) - Rating Form		
Compensation Arrangements	Zurich Municipal policy for KCL + extension assurance	31 July 2008
Peer Review	E-mail from Philippa Garety; comments from Psychology PhD Committee	24 July 2008

Letter from Sponsor	Gill Lambert, Research Governance/Clinical Trials Facilitator, SLam/IoP R&D Office	31 March 2008
Covering Letter		08 August 2008
Protocol	Version 1	
Investigator CV	C.I.s CV - Suzanne Ho-Wai So	07 August 2008
Application		07 August 2008
Questionnaire: Cognitive Biases Questionnaire	Peters et al	
Questionnaire: BAI		
Questionnaire: BDI-II		
Investigator CV	P.I.s CV - Philippa Garety	07 August 2008

Provisional opinion

The Committee would be content to give a favourable ethical opinion of the research, subject to receiving a complete response to the request for further information set out below.

The Committee delegated authority to confirm its final opinion on the application to the Chair.

Further information or clarification required

The REC considered this to be a well written, well thought out application. The REC request confirmation or further clarification about the following points:

1. Please provide clarification about the recruitment process; the order of how and when participants are approached, receive information and by whom.
2. Please provide further information about how you will ensure participants have the capacity to consent.
3. As you are aware there was an issue about the accessing of participants' case notes. You were informed you are not authorised to view the participants' case notes without being given explicit consent to do so. Please confirm whether you intend to seek consent prior to this procedure or whether another individual (i.e. an individual who is part of the patient's clinical care team) will be viewing the medical notes, anonymising the data and then passing it on to you.
4. The REC felt it possible that the patients might think the research was part of their treatment; please ensure participants are aware of the distinction between research and clinical care.

When submitting your response to the Committee, please send revised documentation where appropriate underlining or otherwise highlighting the changes you have made and giving revised version numbers and dates.

The Committee will confirm the final ethical opinion within a maximum of 60 days from the date of initial receipt of the application, excluding the time taken by you to respond fully to the above points. A response should be submitted by no later than 03 February 2009.

Ethical review of research sites

The Committee agreed that all sites in this study should be exempt from site-specific assessment (SSA). There is no need to submit the Site-Specific Information Form to any Research Ethics Committee. However, all researchers and local research collaborators who intend to participate in this study at NHS sites should seek approval from the R&D office for the relevant care organisation.

Membership of the Committee

The members of the Committee who were present at the meeting are listed on the attached sheet.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

08/H0722/76	**Please quote this number on all correspondence**

Yours sincerely

pp **Ms Stephanie Ellis**
Chair

Email: katherine.ouseley@camdenpct.nhs.uk

Enclosures: *List of names and professions of members who were present at the meeting and those who submitted written comments.*

Copy to: *Sponsor and Research Governance contact:*

Mrs Gill Lambert
Research Governance/ Clinical Trials Facilitator
Institute of Psychiatry/ SLAM
Room P005, R&D Office
De Crespigny Park, Denmark Hill
London, SE5 8AF

Camden & Islington Community Local Research Ethics Committee

Attendance at Committee meeting on 29 September 2008

Committee Members:

Name	*Profession*	*Present?*	*Notes*
Dr Simon Adelman	MRC Research Training Fellow	Yes	
Dr Adedoton Adenugba	Staff Doctor	No	
Dr Adam Campbell	Consultant Clinical Psychologist & Senior Clinical Research Fellow	Yes	
Professor David Caplin	Senior Research Investigator, Professor of Physics	No	
Ms Heidi Chandler	PA/Research Administrator	Yes	
Ms Stephanie Ellis (CHAIR)	Former Civil Servant	Yes	
Dr Angela Hassiotis	Senior Lecturer in Learning Disability Psychiatry	Yes	
Mr Matthew Lewin	Journalist and Author	Yes	
Ms Irenie Morley	Assistant Registrar	Yes	
Dr Roshan McClenahan	Reader - Speech & Language Therapy	Yes	
Ms Peggy Papada	Clinical Research Officer	Yes	
Professor Judith Stephenson	Professor of Sexual & Reproductive Health	Yes	
Dr Charlotte Warren-Gash	SpR in Public Health/Academic Clinical Fellow	Yes	
Ms Eleni Yerolaki	Specialist Counsellor	Yes	

Also in attendance:

Name	*Position (or reason for attending)*
Miss Katherine Ouseley	Committee Coordinator – Minutes
Mrs Tanja Wigley	Senior RES Manager – North and East London

Study 2

NHS
National Research Ethics Service
South East Research Ethics Committee
South East Coast Strategic Health Authority
Preston Hall
Aylesford
Kent
ME20 7NJ

Tel: 01622 713097
Fax: 01622 885966

28 May 2009

Ms Suzanne Jolley
Research Clinical Psychologist
Institute of Psychiatry
Department of Psychiatry
De Crespigny Park
London
SE5 8AF

Dear Ms Jolley

Study title: **Psychological Prevention of Relapse in Psychosis: a multicentre randomised controlled trial of cognitive behaviourable therapy and family intervention**
REC reference: **01/1/014**

Amendment number: **9**
Amendment date: **20 April 2009**

The above amendment was reviewed at the meeting of the Sub-Committee of the REC held on 28 May 2009.

Ethical opinion

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

Approved documents

The documents reviewed and approved at the meeting were:

Document	*Version*	*Date*
Covering Letter		07 May 2009
Notice of Substantial Amendment	9	20 April 2009
Participant Information Sheet	II	20 April 2009
Consent Form	II	20 April 2009
Letter to Participants	I	20 April 2009

Membership of the Committee

The members of the Committee who took part in the review are listed on the attached sheet.

R&D approval

All investigators and research collaborators in the NHS should notify the R&D office for the relevant NHS care organisation of this amendment and check whether it affects R&D approval of the research.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

01/1/014:	**Please quote this number on all correspondence**

Yours sincerely

Nicki Watts
Committee Co-ordinator

E-mail: nicki.watts@nhs.net

Enclosures: List of names and professions of members who took part in the review

Copy to:

South East Research Ethics Committee

Attendance at Sub-Committee of the REC meeting on 13 November 2008

Name	*Profession*	*Capacity*
Dr L. Alan Ruben	GP	Expert
Mr Roy Sinclair	Pharmacist	Expert

Study 3

NHS
National Research Ethics Service

South East London Research Ethics Committee (REC) 4
(Formerly known as The Joint South London and Maudsley and Institute of Psychiatry Research Ethics Committee)
South London REC Office (2)
1st Floor, Camberwell Building
94 Denmark Hill
London
SE5 9RS

Telephone: 020 3299 5033
Facsimile: 020 3299 5085

05 July 2010

Ms. Suzanne Ho-wai So
Department of Psychology PO Box 78
Addiction Sciences Building
4 Windsor Walk, London
SE5 8AF

Dear Ms. So

Study Title: **Changes in delusions, belief flexibility and aberrant salience in the first 2 weeks of antipsychotic medication**

REC reference number: **10/H0807/44**
Protocol number:

The Research Ethics Committee reviewed the above application at the meeting held on 18 June 2010. Thank you for attending to discuss the study.

Ethical opinion

The members of the Committee present gave a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

For NHS research sites only, management permission for research ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk. Where the only involvement of the NHS organisation is as a Participant Identification Centre, management permission for research is not required but the R&D office should be

notified of the study. Guidance should be sought from the R&D office where necessary.

Sponsors are not required to notify the Committee of approvals from host organisations.

Other conditions specified by the REC

- Please amend the application to ensure that the relationship of the Researcher to the hospital is made clear;
- Please consider extending the length of time the data is kept for from three to five years;
- Please make clear the process for reimbursement should the participant not complete the study;
- Please amend the Information Sheet to sate that the participant will be reimbursed for their time and not include words such as 'payments';
- Please simplify on the Information Sheet the section that says 'procedures are not invasive. Spell out what this means as the term is too technical;
- Please amend the Information Sheet by removing 'we cannot promise' under benefits, it may be better to say 'you will not benefit directly' or 'does not give any benefits;
- Please amend the Information Sheet to say that we will use the data;
- Please on the information Sheet the contact details again and not include the words 'as above';
- Please review the measure and rename them;
- Please amend the Consent form, must ask for consent for paragraphs two and three;

It is responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

You should notify the REC in writing once all conditions have been met (except for site approvals from host organisations) and provide copies of any revised documentation with updated version numbers.

Approved documents

The documents reviewed and approved at the meeting were:

Document	*Version*	*Date*
Investigator CV	1	27 April 2010
Protocol	1	27 April 2010
CV: Philippa Anne Garety	2	01 January 2007
REC application	2.5	05 May 2010
Covering Letter		30 April 2010
Questionnaire: SAPS	1	01 January 1984
Advertisement	1	27 April 2010
Participant Information Sheet: Psychological response to medication	1	28 April 2010
Participant Consent Form: Psychological response to medication	1	27 April 2010
Questionnaire: PANSS	1	27 April 2010

Questionnaire: PSYRATS	1	27 April 2010
Questionnaire: MADS Belief Maintenance Section	1	27 April 2010
CV: Shitij Kapur	1	05 May 2010
CV: Emmanuelle Roisin Peters	1	05 May 2010
Evidence of insurance or indemnity		01 August 2009

Membership of the Committee

The members of the Ethics Committee who were present at the meeting are listed on the attached sheet.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Now that you have completed the application process please visit the National Research Ethics Service website > After Review

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

We would also like to inform you that we consult regularly with stakeholders to improve our service. If you would like to join our Reference Group please email referencegroup@nres.npsa.nhs.uk.

Please quote this number on all correspondence: 10/H0807/44

With the Committee's best wishes for the success of this project

Yours sincerely

Mr T Eaton
Chair

Email: audrey.adams@nhs.net

Enclosures:	*List of names and professions of members who were present at the meeting and those who submitted written comments* *"After ethical review – guidance for researchers*
Copy to:	*Ms Jenny Liebscher* *R&D office for NHS care organisation at lead site*

South East London REC 4

Attendance at Committee meeting on 18 June 2010

Committee Members:

Name	*Profession*	*Present*	*Notes*
Mrs J Bostock	Lay Member	No	
Prof Nelarine Cornelius	Lay Member	Yes	
Professor T Craig	Professor of Psychiatry	Yes	
Mr T Eaton	Lay Member	No	
Ms Stephanie Ellis	Co-opted Member	Yes	
Dr N Fear	Senior Lecturer in Military Epidemiology	No	
Miss Clare Flach	Deputy Statistician	No	
Dr Daniel Freeman	Senior Lecturer in Clinical Psychology	Yes	
Dr T Joyce	Psychologist	No	
Dr Richard Kanaan	Expert Member	Yes	
Dr V Kumari	Senior Research Fellow in Basic Biomedical Science	Yes	
Dr M Leese	Senior Lecturer in Statistics	No	
Mr R Maddox	Lay Member	Yes	
Evan Stone QC	Lay Member	Yes	
Mr J Watkins	Social Work Representative	Yes	
Cllr Ian Wingfield	Lay Member	No	

Also in attendance:

Name	*Position (or reason for attending)*
Audrey Adams	Co-ordinator

Written comments received from:

Name	*Position*
Dr T Joyce	Psychologist

Appendix 2

Information and consent forms

Study 1

Institute of Psychiatry

at The Maudsley

KING'S College LONDON Founded 1829

University of London

Psychological response to medication
Participant Information Sheet

We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the study?
The purpose of the study is to help us understand how medication you are taking is helping you in the way you think and feel. Scientific research has told us that medications help people deal with some of their upsetting thoughts and emotions, but we still need to understand further the exact mechanisms of how the therapeutic effect happens psychologically and when such effect starts to take place.

Why have I been invited?
In order to help us understand the effect of medication over time, we will be interviewing patients who are at the early stage of taking medication. Since you have just begun/will begin taking medication, we invite you to take part in this study. We are inviting a total of 40 patients to participate in this study.

Do I have to take part?
It is up to you whether or not you decide to take part. We will describe the study and go through this information sheet, which we will then give to you. We will then ask you to sign a consent form to show you have agreed to take part. If you do decide to take part, you can always change your mind at a later stage and withdraw from the study without giving a reason. This would not affect the standard of care you receive.

What will happen to me if I take part?
You will be interviewed by a research psychologist for a total of 5 times within a period of 8 weeks. The interviews will take place in the ward where you are staying, or in a clinic when you have your psychiatric follow-up. The interview times will be arranged between the research psychologist, you, and your care coordinator so as not to disrupt your ward routine or any other clinical service.
The interviews will discuss any distressing unusual experiences you may have and how you think about them. The interviews will also involve you

filling out some questionnaires, with the help of the interviewer. In some of the interviews, you will be asked to do simple and brief experimental tasks presented on the computer, to help us know how you interpret things in general.
The first and last (i.e. at week 8) interviews will take longer, about 1.5-2 hours each. The interviews at week 1, week 2, and week 4, will last between 30 minutes to an hour. You will be allowed to take breaks when needed.

Expenses and payments
£10 per hour of interview will be given to you in order to remunerate you for your time.

What will I have to do?
You will be asked to attend the research interviews at the time and date arranged. You will also need to let the interviewer know whether you are taking the medication regularly.

Will there be any potential risks or restrictions in taking part?
The study procedures are not invasive and will not affect your standard treatment or management. Your medication will not be withheld at any point of the study.

What are the possible benefits of taking part?
We cannot promise the study will give you any direct or immediate benefits, but the information we get from this study will help improve the treatment of people with distressing unusual experiences.

What will happen if I don't want to carry on with the study?
If you withdraw from the study, we will destroy all your identifiable data, but we will need to use the anonymised data collected up to your withdrawal.

Will my taking part in the study be kept confidential?
Yes. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves the hospital will have your name and address removed so that you cannot be recognised. Your identifiable data will be stored securely and only be accessed by authorised persons such as the clinical team and the chief investigator. In the rare occasion where the research process reveals that you or the others are subject to serious risk, confidentiality will have to be broken and the relevant information will need to be disclosed.

What will happen to the results of the study?
Results of the study will be available after all the data have been collected and analysed. The broad scientific results of the study will be published in scientific journals. A summary of the results will be available to participants upon request. You can ask the researcher to send you a copy of the result summary when the study is completed.

Who is organising and funding the project?
The person leading the research is Ms. Suzanne So, who is a Hong Kong-qualified clinical psychologist, and a PhD student at the Institute of Psychiatry, King's College of London. The project is supervised by Prof. Philippa Garety, Prof. Shitij Kapur, and Dr. Emmanuelle Peters.
The project is funded by a Medical Research Council research grant.

What has reviewed the project?
All research in the NHS is looked at by independent group of people, called a Research Ethics Committee, to protect your safety, rights, wellbeing and dignity. This study has been reviewed and given favourable opinion by the Camden and Islington NHS Trust Research Ethics Committee. The study reference number is 08/H0722/76.

Who do I contact for further information?
We encourage you to discuss this with your care coordinator or clinician if you have doubts. If you would like further information please contact Suzanne So (research psychologist) by telephone on 020 7848 5728, or email at suzanne.so@iop.kcl.ac.uk

What if there is a problem?
If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions (contact details as above). If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the hospital.

Thank you for taking the time to read this information sheet.

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PSYCHOLOGICAL RESPONSE TO MEDICATION CONSENT FORM

OFFICE USE ONLY	
Patient identification number:	Participant number:

		Please initial box
1.	I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	
2.	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.	
3.	I agree to take part in the above study.	
4.	I permit the researcher to view my case notes for the purpose of this study.	
5.	I would like to receive a copy of the results of the above study.	

_____	_____	_____
Name of patient	Signature	Date
_____	_____	_____
Name of person taking consent	Signature	Date

Original to be kept in medical notes; one copy each for patient & researcher site file

Study 2

PRP

Psychological Prevention of Relapse in Psychosis

Funded by The Wellcome Trust

Information Sheet

Psychological Prevention of Relapse in Psychosis

Study I: Cognitive Behaviour Therapy compared to Treatment As Usual.

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and members of your health care team if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Some people have unusual, worrying or distressing experiences or beliefs, which bring them into contact with mental health services. We think such experiences may be helped by talking them through with someone, a therapist, who is able to discuss them in detail. This kind of help is called Cognitive Behaviour Therapy (CBT). Cognitive means thoughts, behaviour is what you do and feel. CBT may help you to understand what you are experiencing and feeling, and may help you to cope with it differently, and to feel less worried.

CBT is a relatively new treatment, developed in the last 10 years. We still do not know how exactly it helps people to improve, to prevent relapse, or to continue to manage their problems. This study therefore aims to see whether CBT does help to prevent relapse and to improve our understanding of the treatment so that we can develop it further to be more helpful.

The whole study will involve 500 patients in different Trusts in London and in East Anglia. We are approaching patients who have had a recent recurrence of their symptoms and are inpatients on acute wards, or are in contact with community mental health teams.

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and will be asked to

sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason.

If you do agree to take part, you will either be offered CBT and your usual treatment or your usual treatment with your team alone. This choice of treatment will be made by drawing lots. You will have a one in two chance in receiving the CBT treatment. This is called random allocation to treatment and helps us to make comparisons between people in each group who have a different treatment.

CBT involves weekly or fortnightly meetings for up to one year which will be arranged at a time to suit you. Whether or not you have CBT you will also be asked to meet a research worker and complete regular assessments over one year. Assessments are likely to last between one and two hours over one or more sessions. At the end of the 2nd year you will be asked to complete a final set of assessments to see if any changes that may have occurred are still there. After that you will continue with your usual treatment with you team or with your GP.

We hope that this new treatment will be helpful. However, this cannot be guaranteed. The information we get from this study may help us to improve treatments.

If you consent to take part in the study we will check your medical records for details of your care and other treatment. All information that is collected about you during the course of the research will be kept strictly confidential. Any information about you that leaves the hospital/Trust will have your name and address removed so that you cannot be recognised from it.

If you consent, we will inform your consultant psychiatrist and the team responsible for your care about your involvement in the study. We will send them a very brief summary of our assessment unless you do not wish us to do this.

Since we are trying to provide the very best treatment possible, we would like to audio tape sessions that you have with your therapist. The reason for this is to check that the therapy is carried out in the way that we expect it to be. We will ask you separately for your consent to this.

When the study is finished the results will be published. This is likely to be in 2007. We will not identify you individually in any report or publication of the research.

The research is funded by a medical research charity, called The Wellcome Trust. The research has been considered and approved by the Institute of Psychiatry/South London and Maudsley NHS Trust research ethics committee.

Thank you for reading this, if you need further information please contact a member of the research team, the names of people to contact are given below.

We will give you this information sheet to keep as well as a signed consent form if you agree to take part in the study.

Amy Hardy & Alison Gracie, Research Psychologists, Department of Psychology, Institute of Psychiatry, Denmark Hill, London, SE5 8AF. Tel: 020 7848 0328 Email: A.Hardy@iop.kcl.ac.uk.

Suzanne Jolley, Research Clinical Psychologist, Academic Psychology Department, 3rd Floor, Adamson Centre for Mental Health, Block 8, South Wing, St. Thomas' Hospital, Lambeth Palace Road, London, SE1 7EH. Tel: 020 7928 9292 ext. 1017

PRP

Psychological Prevention of Relapse in Psychosis

Funded by The Wellcome Trust

Information Sheet

Psychological Prevention of Relapse in Psychosis

Study II: Family Intervention, Cognitive Behaviour Therapy or Treatment As Usual.

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and members of your health care team if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Some people may have unusual, worrying or distressing experiences or beliefs, which bring them into contact with mental health services. We think such experiences may be helped by talking them through with someone, a therapist, who is able to discuss and re-evaluate some of the evidence on which they are based. This kind of help is called Cognitive Behaviour Therapy (CBT). Cognitive means thoughts, behaviour is what you do and feel. CBT may help people to understand what they are experiencing and feeling, and may help them to cope with it differently, and to feel less worried.

The experiences of people may also be helped by talking to the person and their family about what is happening, trying to sort out any ongoing problems and to help with the upset and worry that these can cause. This is called Family Intervention (FI). Usually two therapists would come and meet with the person with psychosis and their relatives at home.

FI is a relatively well established kind of treatment whereas CBT is more recent. We still do not know, however, how either of these affect ideas and feelings, and how this continues to be helpful when treatment is finished. More evidence is needed to establish whether one of the treatments is better that the other.

The whole study will involve 500 patients in different Trusts in London and in East Anglia. We are approaching patients and their relatives. The person will have had a recent recurrence of their symptoms and either be an inpatient on an acute ward or be in contact with community mental health teams.

It is up to you and your relative(s) to decide whether or not to take part. We will seek consent from your relative(s) separately. If you do decide to take part, you will be given this information sheet to keep and will be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason.

If you do agree to take part, there are three possibilities.

1) Family Intervention – in this case the person and identified members of the family will be offered meetings with two therapists, fortnightly, for up to a year. There will be an opportunity to have information about the problems of psychosis, help with sorting out everyday problems and help with dealing with the worry and upset that these problems can cause. In addition, the usual clinical care from the mental health team will continue to be offered.

2) Cognitive Behavioural Therapy – in this case the person will be offered weekly to fortnightly individual sessions for up to a year with a therapist. In these sessions the therapist will discuss with the person their worries and experiences, and discuss the reasons for their concerns and how they may cope with them differently and feel less worried. In addition, the usual clinical care from the mental health team will continue to be offered.

3) The person and their relatives will be offered the usual clinical care from the mental health team and will have regular meetings with a research worker to find out how everyone is getting on.

If you consent, CBT or FI or the usual treatment alone will be offered for one year. The choice of treatment will be made by drawing lots. There will be a one in three chance of receiving the CBT treatment, a one in three chance of receiving the family intervention treatment and a one in three chance of receiving the usual care alone. In addition, in all of these cases you will be asked to meet a research worker and complete regular assessments. The assessments are likely to last between one and two hours over one or more sessions. At the end of the second year you will be asked to complete a final set of assessments to see if any changes that may have occurred are still there. After that, you will continue with usual treatment with the mental health team or with the GP.

We hope that these treatments will be helpful. However, this cannot be guaranteed. The information we get from this study may help us to improve treatments.

If you do take part in the study we will check the medical records for details of care and other treatment. All information that is collected about you during the course of the research will be kept strictly confidential. Any information about you that leaves the hospital/Trust will have your name and address removed so that you cannot be recognised from it.

If you consent, we will inform the consultant psychiatrist and the team responsible for your or your relative's care about your involvement in the study. We will send the team a very brief summary of our assessment unless you do not wish us to do this.

Since we are trying to provide the very best treatment possible, we would like to audio tape sessions that you have with the therapist. The reason for this is to check that the therapy is carried out in the way that we expect it to be. We will ask you separately for your consent to this.

When the study is finished the results will be published. This is likely to be in 2007. We will not identify you individually in any report or publication of the research.

The research is funded by a medical research charity, called The Wellcome Trust. The research has been considered and approved by the Institute of Psychiatry/South London and Maudsley NHS Trust research ethics committee.

Thank you for reading this, if you need further information please contact a member of the research team, the names of people to contact are given below.

We will give you this information sheet to keep as well as a signed consent form if you agree to take part in the study.

Amy Hardy & Alison Gracie, Research Psychologists, Department of Psychology, Institute of Psychiatry, Denmark Hill, London, SE5 8AF. Tel: 0207 8480328 Email: A.Hardy@iop.kcl.ac.uk.

Suzanne Jolley, Research Clinical Psychologist, Academic Psychology Department, 3rd Floor, Adamson Centre for Mental Health, Block 8, South Wing, St. Thomas' Hospital, Lambeth Palace Road, London, SE1 7EH. Tel: 0207 9289292 ext. 1017 Email: Suzanne.jolley@kcl.ac.uk

PRP

Psychological
Prevention of
Relapse in Psychosis

F u n d e d b y T h e W e l l c o m e T r u s t

Centre Number:
Study Number: 1
Patient Identification Number for this trial:

CONSENT FORM FOR PARTICIPANT

Title of Project: Psychological Prevention of Relapse in Psychosis
Study I – Cognitive Behavioural Therapy compared to Treatment As Usual.

Name of Researcher:Phil Watson

1. I confirm that I have read and understand the information sheet dated …… (version …….) for the above study and have had the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐

3. I understand that sections of my medical notes may be looked at by the research team or from regulatory authorities where it is relevant to my taking part in research.
   I give permission for these individuals to have access to my records. ☐

4. I agree to take part in the above study. ☐

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Name of Person taking consent (if different from researcher)	Date	Signature
_____	_____	_____
Researcher	Date	Signature

1 for participant; I for researcher; 1 to be kept with hospital notes.

Study 3

STUDY PATIENTS WANTED

Changes in delusions and belief flexibility in antipsychotic treatment

Criteria:

- Any episode of psychosis
- Active delusions
- Not on antipsychotics yet OR been on antipsychotics for <1 week
- Aged 18 or above

Participation:

✓ 3 interviews within 2 weeks
✓ Electronic diary for 2 weeks
✓ Remuneration given (max. £60)

Contact:
Suzanne So, research psychologist, IoP
Tel: 0207 848 5728 Email:suzanne.so@kcl.ac.uk

☺ **Thank you very much** ☺

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Psychological response to medication
Participant Information Sheet

We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the study?
The purpose of the study is to help us understand how medication you are taking is helping you in the way you think and feel. Scientific research has told us that medications help people deal with some of their upsetting thoughts and emotions, but we still need to understand further exactly how the medication effect takes place.

Why have I been invited?
In order to help us understand the effect of medication over time, we will be interviewing patients who are at the early stage of taking medication. Since you have just begun/will begin taking medication, we invite you to take part in this study. We are inviting a total of 25 patients to participate in this study.

Do I have to take part?
It is up to you whether or not you decide to take part. We will describe the study and go through this information sheet, which we will then give to you. We will then ask you to sign a consent form to show you have agreed to take part. If you do decide to take part, you can always change your mind at a later stage and withdraw from the study without giving a reason. This would not affect the standard of care you receive.

What will happen to me if I take part?
You will be asked to answer some questions on a electronic diary. The electronic diary will be programmed on a personal digital assistant (PDA). This will beep 7 times a day during your waking hours for 13 consecutive days. Each time the PDA beeps, you will be required to stop your current activity and immediately complete the diary entry on the PDA. Each diary entry takes only a few minutes to complete. At the first research interview, the interviewer will discuss the questions in detail and practise filling out the diary with you, until you are confident in completing the diary on your own.

The interviewer will discuss with you the questions to be included in the diary. The diary will start the day after the first interview. During the 13-day diary taking, the interviewer will contact you regularly to provide support and answer any questions that may come up about the diary.
You will be interviewed by a research psychologist for a total of 3 times within a period of 2 weeks. The interviews will take place in the ward where you are staying, or in a clinic when you have your psychiatric follow-up. The interview times will be arranged between the research psychologist, you, and your care coordinator so as not to disrupt your ward routine or any other clinical service.
The interviews will discuss any distressing unusual experiences you may have and how you think about them. The interviews will also involve you filling out some questionnaires, with the help of the interviewer. In the first interview, you will be asked to do a simple and brief experimental task presented on the computer, to help us know how you interpret things in general.
The first interview will be the longest and will take half an hour to 1 hour. The follow-up interviews at week 1 and week 2 will last between 15 to 30 minutes. You will be allowed to take breaks when needed.

Remuneration
£10 per hour of interview and £20 per week of diary (i.e. £40 for a complete course of 13 days' diary entries) will be given to you in order to remunerate you for your time.

What will I have to do?
You will be asked to attend the research interviews at the time and date arranged, and to fill out the electronic diary as soon as it beeps. You will also need to let the interviewer know whether you are taking the medication regularly.

Will there be any potential risks or restrictions in taking part?
There are no risks or restrictions in taking part in this study. Study participation will not affect your standard treatment or management. Your medication will not be withheld at any point of the study.

What are the possible benefits of taking part?
Participating in this study does not give you any benefits, but the information we get from this study will help improve the treatment of people with distressing unusual experiences.

What will happen if I don't want to carry on with the study?
If you withdraw from the study, we will destroy all your identifiable data, but we will use the anonymised data collected up to your withdrawal.

Will my taking part in the study be kept confidential?
Yes. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves the hospital will have your name and address removed so that you cannot be recognised. Your identifiable data will be stored securely and

only be accessed by authorised persons such as the clinical team and the chief investigator. In the rare occasion where the research process reveals that you or the others are subject to serious risk, confidentiality will have to be broken and the relevant information will need to be disclosed.

What will happen to the results of the study?
Results of the study will be available after all the data have been collected and analysed. The broad scientific results of the study will be published in scientific journals. A summary of the results will be available to participants upon request. You can ask the researcher to send you a copy of the result summary when the study is completed.

Who is organising and funding the project?
The person leading the research is Ms. Suzanne So, who is a Hong Kong-qualified clinical psychologist, and a PhD student at the Institute of Psychiatry, King's College of London. The project is supervised by Prof. Philippa Garety, Prof. Shitij Kapur, and Dr. Emmanuelle Peters.
The project is funded by a Medical Research Council research grant and the Croucher Foundation Scholarship.

What has reviewed the project?
All research in the NHS is looked at by independent group of people, called a Research Ethics Committee, to protect your safety, rights, wellbeing and dignity. This study has been reviewed and given favourable opinion by the South East London Research Ethics Committee 4. The study reference number is 10/H0807/44.

Who do I contact for further information?
We encourage you to discuss this with your care coordinator or clinician if you have doubts. If you would like further information please contact Suzanne So (research psychologist) by telephone on 020 7848 5728, or email at suzanne.so@kcl.ac.uk. Alternatively, you may contact Prof. Philippa Garety at philippa.garety@kcl.ac.uk.

What if there is a problem?
If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions (email suzanne.so@kcl.ac.uk or philippa.garety@kcl.ac.uk). If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the hospital.

Thank you for taking the time to read this information sheet.

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PSYCHOLOGICAL RESPONSE TO MEDICATION CONSENT FORM

		Please initial box
1.	I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	
2.	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.	
3.	I agree to take part in the above study.	
4.	I permit the researcher to view my case notes for the purpose of this study.	
5.	The personal digital assistant (PDA) is a property of King's College London. I agree to return the PDA to the researcher after this study.	
6.	I would like to receive a copy of the results of the above study.	

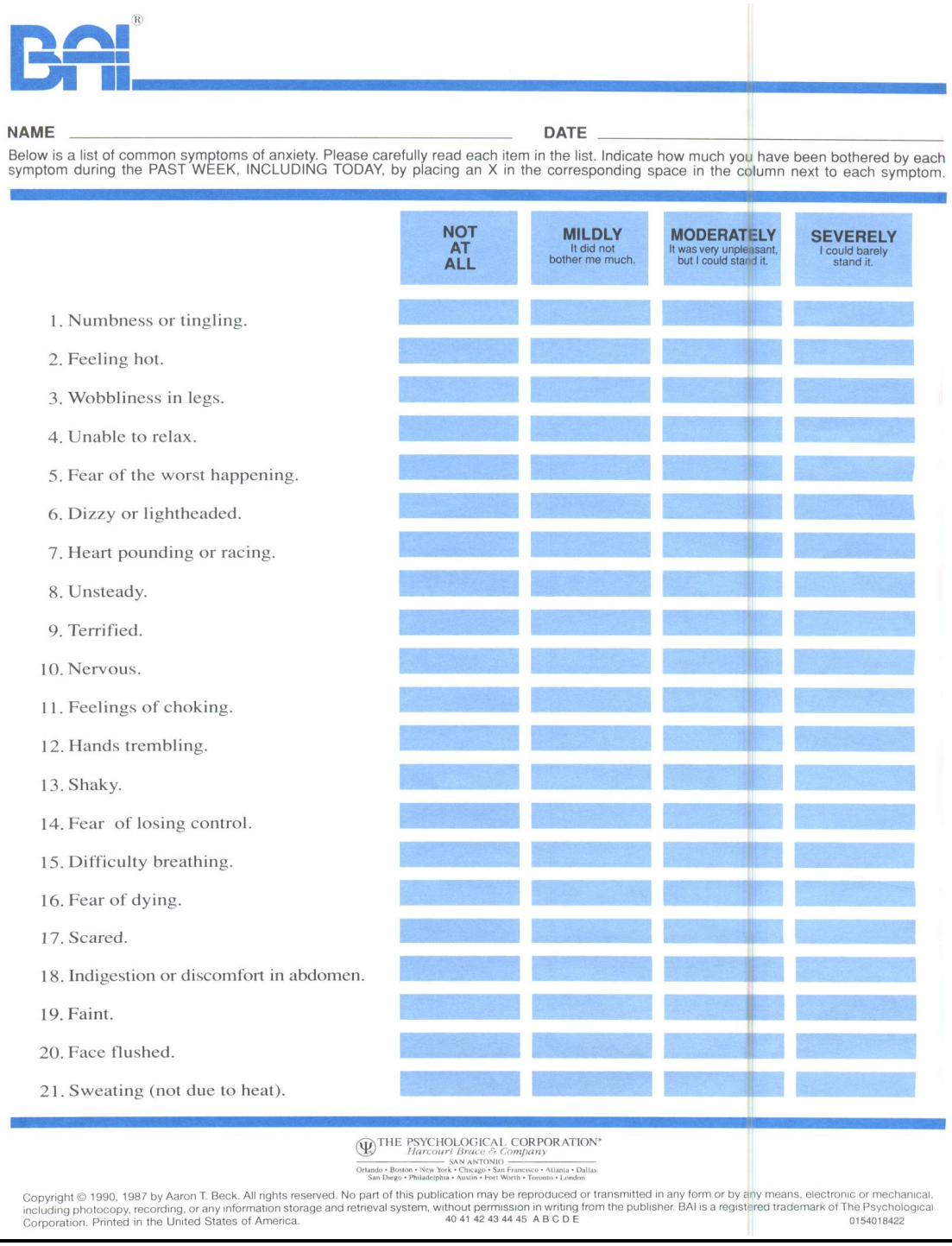
_____	_____	_____
Name of participant	Signature	Date
_____	_____	_____
Name of person taking consent	Signature	Date

Original to be kept in medical notes; one copy each for patient & researcher site file

Appendix 3

Measures of all studies

BECK ANXIETY INVENTORY (Study 1)



NAME _____ DATE _____

Below is a list of common symptoms of anxiety. Please carefully read each item in the list. Indicate how much you have been bothered by each symptom during the PAST WEEK, INCLUDING TODAY, by placing an X in the corresponding space in the column next to each symptom.

	NOT AT ALL	MILDLY It did not bother me much.	MODERATELY It was very unpleasant, but I could stand it.	SEVERELY I could barely stand it.
1. Numbness or tingling.				
2. Feeling hot.				
3. Wobbliness in legs.				
4. Unable to relax.				
5. Fear of the worst happening.				
6. Dizzy or lightheaded.				
7. Heart pounding or racing.				
8. Unsteady.				
9. Terrified.				
10. Nervous.				
11. Feelings of choking.				
12. Hands trembling.				
13. Shaky.				
14. Fear of losing control.				
15. Difficulty breathing.				
16. Fear of dying.				
17. Scared.				
18. Indigestion or discomfort in abdomen.				
19. Faint.				
20. Face flushed.				
21. Sweating (not due to heat).				

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40 41 42 43 44 45 A B C D E

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BECK DEPRESSION INVENTORY – II (Study 1)

BDI-II

Date:

Name: _____ Marital Status: _____ Age: _____ Sex: _____

Occupation: _____ Education: _____

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the **one statement** in each group that best describes the way you have been feeling during the **past two weeks, including today**. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness
- 0 I do not feel sad.
- 1 I feel sad much of the time.
- 2 I am sad all the time.
- 3 I am so sad or unhappy that I can't stand it.

2. Pessimism
- 0 I am not discouraged about my future.
- 1 I feel more discouraged about my future than I used to be.
- 2 I do not expect things to work out for me.
- 3 I feel my future is hopeless and will only get worse.

3. Past Failure
- 0 I do not feel like a failure.
- 1 I have failed more than I should have.
- 2 As I look back, I see a lot of failures.
- 3 I feel I am a total failure as a person.

4. Loss of Pleasure
- 0 I get as much pleasure as I ever did from the things I enjoy.
- 1 I don't enjoy things as much as I used to.
- 2 I get very little pleasure from the things I used to enjoy.
- 3 I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings
- 0 I don't feel particularly guilty.
- 1 I feel guilty over many things I have done or should have done.
- 2 I feel quite guilty most of the time.
- 3 I feel guilty all of the time.

6. Punishment Feelings
- 0 I don't feel I am being punished.
- 1 I feel I may be punished.
- 2 I expect to be punished.
- 3 I feel I am being punished.

7. Self-Dislike
- 0 I feel the same about myself as ever.
- 1 I have lost confidence in myself.
- 2 I am disappointed in myself.
- 3 I dislike myself.

8. Self-Criticalness
- 0 I don't criticize or blame myself more than usual.
- 1 I am more critical of myself than I used to be.
- 2 I criticize myself for all of my faults.
- 3 I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes
- 0 I don't have any thoughts of killing myself.
- 1 I have thoughts of killing myself, but I would not carry them out.
- 2 I would like to kill myself.
- 3 I would kill myself if I had the chance.

10. Crying
- 0 I don't cry anymore than I used to.
- 1 I cry more than I used to.
- 2 I cry over every little thing.
- 3 I feel like crying, but I can't.

_____ Subtotal Page 1

Continued on Back

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CARDS TASK (Study 1)

How do you think this was done?

To what extent do you believe in each of the following explanations?

1. It works because the system is able to read people's minds.

Do not believe this at all ——————————— Totally believe this

Please circle one of the two options below:
It works only for me / It would work for everybody

2. It is not the computer which guessed; there is someone involved behind this.

Do not believe this at all ——————————— Totally believe this

Please circle one of the two options below:
It works only for me / It would work for everybody

3. It is a trick that is part of a bigger conspiracy by others against me.

Do not believe this at all ——————————— Totally believe this

Please circle one of the two options below:
It works only for me / It would work for everybody

4. It was done to trick me or make me look stupid.

Do not believe this at all ——————————— Totally believe this

Please circle one of the two options below:
It works only for me / It would work for everybody

5. It is just a puzzle.

Do not believe this at all ——————————— Totally believe this

Please circle one of the two options below:
It works only for me / It would work for everybody

6. It is related to some of my recent experiences.

Do not believe this at all ——————————— Totally believe this

Specify (optional):

CLINICAL GLOBAL IMPRESSIONS (Study 1)

DATE: _____

PATIENT NAME: _____

RATER'S NAME & TITLE: _____

Please kindly circle the number that would best represent your clinical impression of this patient.

SEVERITY OF ILLNESS
Considering your total clinical experience with this particular population, how ill is the patient at this time?

1 normal/ not ill
2 borderline mentally ill, not at all ill
3 mildly ill
4 moderately ill
5 markedly ill
6 severely ill
7 among the most extremely ill patients

GLOBAL IMPROVEMENT
Compared to his/her condition at admission to the hospital, how much has the patient changed?

1 very much improved
2 much improved
3 minimally improved
4 no change
5 minimally worse
6 much worse
7 very much worse

THANK YOU VERY MUCH for taking the time to rate this patient.

COGNITIVE BIASES QUESTIONNAIRE FOR PSYCHOSIS (Study 1)

INSTRUCTIONS

In this questionnaire you will find a number of descriptions of everyday events. After each situation are different ways that people might react, labelled A, B, or C. Please imagine yourself in each situation as vividly as possible.

Once you have imagined that the event is happening to you, please choose the option that best describes how you might think about the situation. If none of the options matches completely how you might react, choose the one which is the closest. If more than one option applies, choose the one which would run through your mind most often. When you have decided which option you are most likely to think, put a circle around the letter next to it.

There are no right or wrong answers. Work through the questions fairly quickly, making sure you pick the option that is nearest to what your *immediate* reaction might be.

1. Imagine you receive a letter and you notice it is not sealed. *I am most likely to think: (please circle A, B or C)*	**A**: Someone has deliberately opened this letter already **B**: I wonder if this may have been opened again after it was written **C:** I don't think anything of it
2. Imagine that you are walking down the street when you hear your name being called, but when you look around you don't see anybody. *I am most likely to think: (please circle A, B or C)*	**A:** Something strange is going on **B:** There is something really dangerous about this **C:** I must be imagining things
3. Imagine your food tastes different from usual. *I am most likely to think: (please circle A, B or C)*	**A:** Someone may have done something to my food on purpose **B:** This food must have been prepared with a different ingredient today **C:** Someone has deliberately spiked my food
4. Imagine that on your way to work you notice that all the traffic lights turn red as you approach them. *I am most likely to think: (please circle A, B or C)*	**A:** It's going to take me longer to get in this morning **B:** That's all I need, I'm going to be really late now **C:** My day is going to be ruined

5. Imagine you are standing at a bus stop when the bus you have been waiting for drives past half empty without stopping. *I am most likely to think: (please circle A, B or C)*	**A:** People are always so nasty **B:** People aren't very nice sometimes **C:** The driver must be in a bad mood today
6. Imagine you have a really bad pain in your head. *I am most likely to think: (please circle A, B or C)*	**A:** There must be something wrong with me **B:** There's lots of different reasons why I might have this pain **C:** I must have something really serious, like a brain tumour
7. Imagine that while on the bus you notice a stranger staring at you. *I am most likely to think: (please circle A, B or C)*	**A:** The way this person is staring at me is a bit worrying **B:** This person must mean me harm to be staring at me that way **C:** This person is being really rude to be staring at me in that way
8. Imagine you are sitting at home and suddenly you feel very odd. *I am most likely to think: (please circle A, B or C)*	**A:** I wonder why I feel odd, could something sinister be going on somewhere **B:** This feeling is proof that there is something bad happening somewhere to someone I know **C:** I must be over-tired or something
9. Imagine you applied for a job and did not get it. *I am most likely to think: (please circle A, B or C)*	**A:** Perhaps I can get some feedback about why I did not get the job **B:** I wonder if I did not do very well at interview **C:** I'll never be able to get a job
10. Imagine that you are on a train when you suddenly have a strong feeling you have been there before. *I am most likely to think: (please circle A, B or C)*	**A:** This is some kind of premonition that something awful has happened or will happen **B:** I wonder whether this is some kind of premonition **C:** This is a weird, but common experience
11. Imagine you get turned down to go out by someone you like or a friend. *I am most likely to think: (please circle A, B or C)*	**A:** I quite often get rejected in this situation **B:** You win some, you lose some **C:** I always get rejected for anything I try

12. Imagine that one day you enter a shop and you hear people laughing. *I am most likely to think: (please circle A, B or C)*	**A:** They must be laughing at me **B:** I wonder if they are laughing at me **C:** The laughing is probably nothing to do with me
13. Imagine there are police cars outside your house. You suddenly realise you feel uncomfortable. *I am most likely to think: (please circle A, B or C)*	**A:** Funny how just seeing the police has this unsettling effect on people **B:** I wonder why I feel so uncomfortable, could the cars be something to do with me **C:** I must have done something wrong to feel so uncomfortable, they've come to get me
14. Imagine you are watching television, and suddenly the screen goes blank. *I am most likely to think: (please circle A, B or C)*	**A:** Weird things are always happening **B:** This sort of thing seems to happen quite a lot **C:** There must be something wrong with the TV today
15. Imagine two people in a queue at a supermarket both look your way at the same time and then immediately start to talk to each other. *I am most likely to think: (please circle A, B or C)*	**A:** This is not the first time this has happened **B:** This sort of thing can happen in queues **C:** This always happens wherever I go
16. Imagine you are waiting in a café for an acquaintance to arrive, and you suddenly feel a strange shivery feeling inside. *I am most likely to think: (please circle A, B or C)*	**A:** Feeling shivery is a bad omen, I don't think I should meet this person **B:** I must be nervous about meeting this person **C:** I wonder if feeling shivery means something bad might happen
17. Imagine you think you see a shadowy figure moving across the wall of an empty room. *I am most likely to think: (please circle A, B or C)*	**A:** I wonder what that was **B:** My eyes must be playing tricks on me **C:** There must have been someone or something there
18. Imagine that the phone rings. When you answer, the other party hangs up. *I am most likely to think: (please circle A, B or C)*	**A:** I wonder if there's something suspicious about this **B: S**omebody is definitely checking up on me **C:** Someone's probably got the wrong number

19. Imagine you are watching the news on TV about a recent disaster, and you find yourself feeling guilty. *I am most likely to think: (please circle A, B or C)*	**A:** If I feel guilty I must be responsible in some way **B:** It's normal to feel guilty when a disaster has happened to someone else **C:** I wonder why I feel guilty, maybe I'm unwittingly responsible in some way
20. Imagine you are listening to the radio and suddenly there is crackling interference. *I am most likely to think: (please circle A, B or C)*	**A:** Someone has deliberately tampered with my radio so that it is no longer tuned properly **B:** I wonder if someone has been fiddling with my radio **C:** There is some sort of interference on the radio waves
21. Imagine that you are sitting on a train, and you think you can hear two people behind you talking about you. When you look round they are reading their papers and not talking to each other. *I am most likely to think: (please circle A, B or C)*	**A:** They were definitely talking about me, they're just pretending to be reading their paper **B:** I'm sure I heard them talking about me, maybe I was wrong **C:** I should find out if anyone else ever has this kind of experience before deciding what really happened
22. Imagine you are at home; everything is quiet when you hear a sudden fast banging on the walls. *I am most likely to think: (please circle A, B or C)*	**A:** The neighbours are doing this deliberately to upset me **B:** The neighbours could be doing some kind of home improvements **C:** The neighbours might be trying to tell me something
23. Imagine you a reading a newspaper or magazine, and you read an article which has some special relevance to you. *I am most likely to think: (please circle A, B or C)*	**A:** This article seems to have been written with people like me in mind **B:** I wonder if someone may have written this article for me **C:** Someone has definitely written this article for me specifically
24. Imagine you notice that a person you don't know is looking at you. You suddenly find yourself feeling unsettled. *I am most likely to think: (please circle A, B or C)*	**A:** Feeling this unsettled means this person intends to do me harm **B:** I wonder why I feel this unsettled, could this mean this person is thinking bad things about me **C:** Being looked at can make people feel unsettled, I don't worry about it

25. Imagine that one evening you are sitting at home alone when a door suddenly slams by itself in another room. *I am most likely to think: (please circle A, B or C)*	**A:** Someone or something must have got into the house **B:** I wonder if somebody or something's there **C:** It's probably a draught
26. Imagine someone you know calls you just as you were thinking about them. As you pick up the phone you suddenly realise you are feeling upset. *I am most likely to think: (please circle A, B or C)*	**A:** It's odd that I should feel upset, but I don't read too much into it **B:** I wonder why I feel upset, could there be something peculiar about this call **C:** Feeling upset means something, it must be bad news
27. Imagine you are walking down the road when you suddenly notice a careers poster which seems to stand out from your surroundings. *I am most likely to think: (please circle A, B or C)*	**A:** I wonder why my eyes seem so drawn to that poster **B:** Maybe I'm noticing it because my career isn't such a success **C:** It's a sign that my life is such a failure
28. Imagine you are on a bus; the driver keeps stopping abruptly, so that you stumble each time. *I am most likely to think: (please circle A, B or C)*	**A:** I wonder if he's doing it on purpose to wind people up **B:** This bus driver can't drive properly **C:** He's doing it on purpose to humiliate me
29. Imagine you hear that a friend is having a party and you have not been invited. *I am most likely to think: (please circle A, B or C)*	**A:** I wonder if they don't like me as much as I thought they did **B:** Perhaps I can try to find out a bit more about the situation before making any assumptions **C:** They obviously don't like me
30. Imagine you are dozing on the sofa in front of the TV and you suddenly wake up startled. *I am most likely to think: (please circle A, B or C)*	**A:** I tend to always wake up startled when I'm dozing **B:** The TV must have woken me **C:** I can never get any sleep

Thank you for taking the time to complete the questionnaire

MAUDSLEY ASSESSMENT OF DELUSIONS SCALE
BELIEF MAINTENANCE SECTION (All studies)

1.01 How sure are you about X? Do you have any doubts at all?

4 Absolutely certain
3 Almost certain
2 Quite certain
1 Have some doubts
0 Doubt it

2. Belief maintenance factors

Can you now explain why you continue to think that X is so? Has anything happened since the idea first came to you?

2.01	Experiences since formation	1 Yes 0 No
2.02	Experiences in last week	1 Yes 0 No
2.03	Internal state maintaining belief in last week (e.g. mood, abnormal experience, AH)	1 Yes: _____ 0 No
2.04	External events maintaining belief in last week (e.g. genuine events misinterpreted)	1 Yes: _____ 0 No
2.05	Did you look for any evidence or information to check whether X is true or not?	1 Yes :_____ 0 No
2.06	Asking you to think about it now – can you think of anything at all that has happened that goes against your belief	1 Yes: _____ 0 No
2.07	When you think about it now is it at all possible that you are mistaken about X?	1 Yes 1 Maybe 1 No with hesitation 0 No
2.08	Let me suggest something hypothetical to you – Something that does not fit with your view and you could tell me how you think you would react. Qn.: _____ Ans.: _____	3 Ignores or rejects relevance 2 Accommodates into system 1 Changes level of conviction 0 Dismisses belief

PERSONAL QUESTIONNAIRE & VISUAL ANALOGUE SCALE (Study 1)

How sure/certain are you about X	4	I am absolutely certain that X
	3	I believe very strongly that X
	2	I believe that X
	1	I have some doubts that X
	0	I do not/ no longer believe that X

0 ____ 100

How much have you been thinking/worrying about X	4	I think/worry about X absolutely all of the time
	3	I think/worry about X most of the time
	2	I think/worry about X some of the time
	1	I think/worry about X occasionally
	0	I do not think/worry about X any more

0 ____ 100

How (distressed) have you been about X	4	When thinking about X I feel extremely (emotion)
	3	When thinking about X I feel very (emotion)
	2	When thinking about X I feel quite (emotion)
	1	When thinking about X I feel slightly (emotion)
	0	When thinking about X I do not/ no longer feel (emotion)

0 ____ 100

How much has X been affecting/ getting in the way of your life	4	X affects my life completely
	3	X affects my life greatly
	2	X affects my life quite a bit
	1	X affects only some parts of my life
	0	X doesn't affect my life (anymore)

0 ____ 100

POSITIVE AND NEGATIVE SYNDROME SCALE (All studies)

		Absent	Minimal	Mild	Moderate	Mod-severe	Severe	Extreme
Positive Scale								
P1	Delusions	1	2	3	4	5	6	7
P2	Conceptual disorganisation	1	2	3	4	5	6	7
P3	Hallucinatory behaviour	1	2	3	4	5	6	7
P4	Excitement	1	2	3	4	5	6	7
P5	Grandiosity	1	2	3	4	5	6	7
P6	Suspiciousness	1	2	3	4	5	6	7
P7	Hostility	1	2	3	4	5	6	7
Negative Scale								
N1	Blunted affect	1	2	3	4	5	6	7
N2	Emotional withdrawal	1	2	3	4	5	6	7
N3	Poor rapport	1	2	3	4	5	6	7
N4	Passive/ apathetic social withdrawal	1	2	3	4	5	6	7
N5	Difficulty in abstract thinking	1	2	3	4	5	6	7
N6	Lack of spontaneity & flow of conversation	1	2	3	4	5	6	7
N7	Stereotyped thinking	1	2	3	4	5	6	7
General Psychopathology Scale								
G1	Somatic concern	1	2	3	4	5	6	7
G2	Anxiety	1	2	3	4	5	6	7
G3	Guilt feelings	1	2	3	4	5	6	7
G4	Tension	1	2	3	4	5	6	7
G5	Mannerisms & posturing	1	2	3	4	5	6	7
G6	Depression	1	2	3	4	5	6	7
G7	Motor retardation	1	2	3	4	5	6	7
G8	Uncooperativeness	1	2	3	4	5	6	7
G9	Unusual thought content	1	2	3	4	5	6	7
G10	Disorientation	1	2	3	4	5	6	7
G11	Poor attention	1	2	3	4	5	6	7
G12	Lack of judgement & insight	1	2	3	4	5	6	7
G13	Disturbance of volition	1	2	3	4	5	6	7
G14	Poor impulse control	1	2	3	4	5	6	7
G15	Preoccupation	1	2	3	4	5	6	7
G16	Active social avoidance	1	2	3	4	5	6	7

Positive scale (PANSS-P): _____
Negative scale (PANSS-N): _____
General psychopathology (PANSS-G): _____
Total score (P+N+G): _____

PSYCHOTIC RATING SCALE (All studies)

Auditory hallucinations

Content: _____

1	Frequency

How often do you experience voices? e.g. every day, all day long, etc.

0 Voices not present or present less than once a week (specify frequency if present)
1 Voices occur for at least once a week
2 Voices occur at least once a day
3 Voices occur at least once an hour
4 Voices occur continuously or almost continually i.e. stop only for a few seconds or minutes

2	Duration

When you hear your voices, how long do they last
e.g. few seconds, minutes, hours, all day long?

0 Voices not present
1 Voices last for a few seconds, fleeting voices
2 Voices last for several minutes
3 Voices last for at least one hour
4 Voices last for hours at a time

3	Location

When you hear your voices where do they sound like they're coming from?
- *Inside your head and/or outside your head?*
- *If voices sound like they are outside your head, whereabouts do they sound like they're coming from?*

0 Voices not present
1 Voices originate inside head only
2 Voices outside the head, but close to ears or head
Voices inside the head may also be present
3 Voices originate inside or close to ears and outside head away from ears
4 Voices originate from outside space, away from head only

4	Loudness

How loud are your voices?
Are they louder than your voice, about the same loudness, quieter or just a whisper?

0 Voices not present
1 Quieter than own voice, whispers
2 About same loudness as own voice
3 Louder than own voice
4 Extremely loud, shouting

5 Beliefs re. origin of voices

What do you think has caused your voices?

- *Are the voices caused by factors related to yourself or solely due to other people or factors?*
- *If external: How much do you believe that your voices are caused by (patient's attribution) on a scale from 0-100 with 100 being that you are totally convinced, have no doubts and 0 being that it is completely untrue?*

0 Voices not present
1 Believes voices to be solely internally generated and related to self
2 Holds < 50% conviction that voices originate from external causes
3 Holds ≥ 50% conviction (but < 100%) that voices originate from external cause
4 Believes voices are solely due to external causes (100% conviction)

6 Amount of negative content of voices

Do your voices say unpleasant or negative things?

- *Can you give me some examples of what the voices say? e.g. _____*
- *How much of the time do the voices say these type of unpleasant or negative items?*

0 No unpleasant content
1 Occasional unpleasant content
2 Minority of voice content is unpleasant or negative (< 50%)
3 Majority of voice content is unpleasant or negative (> 50%)
4 All of voice content is unpleasant or negative

7 Degree of negative content

0 Not unpleasant or negative
1 Some degree of negative content, but not personal comments relating to self or family e.g. swear words or commands not directed to self e.g. "the milkman's ugly"
2 Personal verbal abuse, comments on behaviour e.g. "shouldn't do that or say that"
3 Personal verbal abuse relating to self-concept e.g. "you're lazy, ugly, mad, perverted"
4 Personal threats to self e.g. threats to harm to self or family, extreme instructions or commands to harm self or others and personal verbal abuse as in #3

8 Amount of distress

Are your voices distressing? How much of the time?

0 Voices not distressing at all
1 Voices occasionally distressing, majority not distressing
2 Equal amounts of distressing and non-distressing voices
3 Majority of voices distressing, minority not distressing
4 Voices always distressing

9 Intensity of distress

When voices are distressing, how distressing are they?
- *Do they cause you minimal, moderate, severe distress?*
- *Are they the most distressing they have ever been?*

0 Voices not distressing at all
1 Voices slightly distressing
2 Voices are distressing to a moderate degree
3 Voices are very distressing, although subject could feel worse
4 Voices are extremely distressing, feel the worst he/she could possibly feel

10 Disruption to life caused by voices

How much disruption do the voices cause to your life?
- *Do the voices stop you from working or other daytime activity?*
- *Do they interfere with your relationships with friends and/or family?*
- *Do they prevent you from looking after yourself, e.g. bathing, changing clothes etc?*

0 No disruption to life, able to maintain independent living with no problems in daily living skills. Able to maintain social and family relationships (if present)
1 Voices cause minimal amount of disruption to life e.g. interferes with concentration although able to maintain daytime activity and social and family relationships and be able to maintain independent living without support
2 Voices cause moderate amount of disruption to life causing some disturbance to daytime activity and/or family or social activities. The patient is not in hospital although may live in supported accommodation or receive additional help with daily living skills.
3 Voices cause severe disruption to life so that hospitalisation is usually necessary. The patient is able to maintain some daily activities, self-care and relationships whilst in hospital. The patient may also be in supported accommodation but experiencing severe disruption of life in terms of activities, daily living skills and/or relationships.
4 Voices cause complete disruption of daily life requiring hospitalisation. The patient is unable to maintain any daily activities and social relationships. Self-care is also severely disrupted.

11 Controllability of voices

Do you think you have any control over when your voices happen?
Can you dismiss or bring on your voices?

0 Subject believes they can have control over their voices and can always bring on or dismiss them at will
1 Subject believes they can have some control over the voices on the majority of occasions
2 Subject believes they can have some control over their voices approximately half of the time
3 Subject believes they can have some control over their voices but only occasionally. The majority of time the subject experiences voices which are incontrollable
4 Subject has no control over when the voices occur and cannot dismiss or bring them on at all

Delusions

Content: _____

1	Amount of preoccupation with delusions

How often do you think about your beliefs?

0 No delusions, or delusions which the subject thinks about less than once a week
1 Subject thinks about beliefs at least once a week
2 Subject thinks about beliefs at least once a day
3 Subject thinks about beliefs at least once an hour
4 Subject thinks about delusions continuously or almost continuously

2	Duration of preoccupation with delusions

How long do you spend thinking about your beliefs?

0 No delusions
1 Thoughts about beliefs last for a few seconds, fleeting thoughts
2 Thoughts about delusions last for several minutes
3 Thoughts about delusions last for at least one hour
4 Thoughts about delusions usually last for hours at a time

3	Conviction

On a scale 0-100, how much do you believe your thoughts to be true?

0 No conviction at all
1 Very little conviction in reality of beliefs (< 10%)
2 Some doubts relating to conviction in beliefs (10-49%)
3 Conviction in beliefs is very strong (50-99%)
4 Conviction is 100%

4	Amount of distress

How often do your beliefs cause you distress?

0 Beliefs never cause distress
1 Beliefs cause distress on the minority of occasions
2 Beliefs cause distress on < 50% of occasions
3 Beliefs cause distress on the majority of occasions when they occur (50-99% of the time)
4 Beliefs always cause distress when they occur

5	Intensity of distress

How much distress do your beliefs cause you?

0 No distress
1 Beliefs cause slight distress
2 Beliefs cause moderate distress
3 Beliefs cause marked distress
4 Beliefs cause extreme distress, could not be worse

6	Disruption to life caused by beliefs

What is the degree of disruption to your life as a result of these beliefs?

0 No disruption to life, able to maintain independent living with no problems in daily living skills. Able to maintain social and family relationships (if present)
1 Beliefs cause minimal amount of disruption to life e.g. interferes with concentration although able to maintain daytime activity and social and family relationships and be able to maintain independent living without support
2 Beliefs cause moderate amount of disruption to life causing some disturbance to daytime activity and/or family or social activities. The patient is not in hospital although may live in supported accommodation or receive additional help with daily living skills.
3 Beliefs cause severe disruption to life so that hospitalisation is usually necessary. The patient is able to maintain some daily activities, self-care and relationships whilst in hospital. The patient may also be in supported accommodation but experiencing severe disruption of life in terms of activities, daily living skills and/or relationships.
4 Beliefs cause complete disruption of daily life requiring hospitalisation. The patient is unable to maintain any daily activities and social relationships. Self-care is also severely disrupted.

Scores

Auditory hallucinations		**Delusions**	
1. Frequency		1. Amount of preoccupation	
2. Duration		2. Duration of preoccupation	
3. Location		3. Conviction	
4. Loudness		4. Amount of distress	
5. Beliefs re-origin of voices		5. Intensity of distress	
6. Amount of negative content		6. Disruption to life	
7. Degree of negative content			
8. Amount of distress			
9. Intensity of distress		AH scale score	
10. Disruption to life		Delusions scale score	
11. Controllability		Composite total score	

SCALE FOR THE ASSESSMENT OF POSITIVE SYMPTOMS (Studies 2 & 3)

		None	Quest-ionable	Mild	Moderate	Marked	Severe
Hallucinations							
H1	Auditory hallucinations	0	1	2	3	4	5
H2	Voices commenting	0	1	2	3	4	5
H3	Voices conversing	0	1	2	3	4	5
H4	Somatic or tactile hallucinations	0	1	2	3	4	5
H5	Olfactory hallucinations	0	1	2	3	4	5
H6	Visual hallucinations	0	1	2	3	4	5
H7	Global rating of severity	0	1	2	3	4	5
Delusions							
D1	Persecutory delusions	0	1	2	3	4	5
D2	Delusions of jealousy	0	1	2	3	4	5
D3	Delusions of sin or guilt	0	1	2	3	4	5
D4	Grandiose delusions	0	1	2	3	4	5
D5	Religious delusions	0	1	2	3	4	5
D6	Somatic delusions	0	1	2	3	4	5
D7	Ideas and delusions of reference	0	1	2	3	4	5
D8	Delusions of being controlled	0	1	2	3	4	5
D9	Delusions of mind reading	0	1	2	3	4	5
D10	Thought broadcasting	0	1	2	3	4	5
D11	Thought insertion	0	1	2	3	4	5
D12	Thought withdrawal	0	1	2	3	4	5
D13	Global rating of severity	0	1	2	3	4	5
Bizarre behaviour							
B1	Clothing & appearance	0	1	2	3	4	5
B2	Social & sexual behaviour	0	1	2	3	4	5
B3	Aggressive & agitated behaviour	0	1	2	3	4	5
B4	Repetitive or stereotyped behaviour	0	1	2	3	4	5
B5	Global rating of severity	0	1	2	3	4	5
Positive formal thought disorder							
F1	Derailment (loose associations)	0	1	2	3	4	5
F2	Tangentiality	0	1	2	3	4	5
F3	Incoherence (word salad, schizophasia)	0	1	2	3	4	5
F4	Illogicality	0	1	2	3	4	5
F5	Circumstantiality	0	1	2	3	4	5
F6	Pressure of speech	0	1	2	3	4	5
F7	Distractible speech	0	1	2	3	4	5
F8	Clanging	0	1	2	3	4	5
F9	Global rating of severity	0	1	2	3	4	5
A1	**Inappropriate affect**	0	1	2	3	4	5

SUBJECTIVE UNIT OF DISTRESS SCALE (Study 1)

How upset have you been in the last week?

Not upset at all _____ Extremely upset

Appendix 4

Supplementary results of Study 1 using the Psychotic Rating Scales (PSYRATS) and the Personal Questionnaire (PQ)

As the first study focusing on changes in delusional dimensions in response to antipsychotic treatment, Study 1 included three measures of delusional dimensions –Visual Analogue Scale (VAS), Psychotic Rating Scales (PSYRATS; (Haddock *et al.*, 1999), and Personal Questionnaire (Shapiro, 1961). For the sake of succinctness, only results of VAS were reported in Chapter 3. VAS was chosen as it is more sensitive to the idiosyncratic nature of individuals' delusions, provides a continuous measure, and has the greatest range of ratings. This appendix presents analyses of the key research question (Hypothesis 1, i.e. change of delusional dimensions) measured by PSYRATS and PQ, using the same statistical approach as reported in Chapter 3.

A.1 Hypothesis 1: Delusional distress, preoccupation and impact on functioning will reduce before delusional conviction

A.1.1 Delusional dimensions at each time point

Mean scores of delusional dimensions on PSYRATS and PQ at different time points are shown in Tables A.1 and A.2. Pearson correlations of the four dimensions at each time point are shown in Tables A.3 and A.4.

Table A.1

Mean levels (SD) of delusional dimensions on PSYRATS

	Week 0 (n = 40)	Week 1 (n = 36)	Week 2 (n = 37)	Week 4 (n = 30)	Week 8 (n = 32)
Conviction	3.63 (0.67)	2.92 (1.13)	2.54 (1.39)	2.40 (1.52)	2.25 (1.63)
Preoccupation	2.64 (0.95)	2.01 (0.85)	1.87 (1.12)	1.73 (1.19)	1.77 (1.43)
Distress	3.10 (1.12)	2.38 (1.51)	2.23 (1.45)	2.45 (1.41)	2.08 (1.46)
Disruption	3.15 (0.36)	2.94 (0.41)	2.41 (1.01)	2.03 (1.25)	1.44 (1.27)

Table A.2

Mean levels (SD) of delusional dimensions on PQ

	Week 0 (n = 38)	Week 1 (n = 36)	Week 2 (n = 36)	Week 4 (n = 30)	Week 8 (n = 32)
Conviction	3.13 (1.19)	2.50 (1.44)	2.11 (1.58)	2.07 (1.64)	2.00 (1.59)
Preoccupation	2.50 (1.27)	1.83 (1.38)	1.61 (1.34)	1.70 (1.32)	1.84 (1.42)
Distress	2.66 (1.32)	2.33 (1.51)	1.83 (1.58)	2.23 (1.57)	1.75 (1.39)
Disruption	3.11 (1.06)	2.22 (1.40)	2.08 (1.52)	2.13 (1.50)	1.78 (1.62)

Table A.3

Pearson correlations of delusional dimensions on PSYRATS at each time point

		Week 0 (n = 40)			
		Conviction	Preoccupation	Distress	Disruption
Week 0	Conviction	1			
	Preoccupation	0.45 $p<.01$	1		
	Distress	0.15 $p=.34$	0.17 $p=.28$	1	
	Disruption	0.13 $p=.41$	0.35 $p=.03$	0.25 $p=.13$	1
		Week 1 (n = 36)			
		Conviction	Preoccupation	Distress	Disruption
Week 1	Conviction	1			
	Preoccupation	0.25 $p=.14$	1		
	Distress	0.39 $p=.02$	0.49 $p<.01$	1	

	Disruption	0.05 *p*=.77	0.04 *p*=.80	-0.35 *p*=.84	1
		Week 2 (n = 37)			
		Conviction	Preoccupation	Distress	Disruption
Week 2	Conviction	1			
	Preoccupation	0.48 *p*<.01	1		
	Distress	0.51 *p*<.01	0.60 *p*<.01	1	
	Disruption	0.33 *p*=.04	0.16 *p*=.35	0.33 *p*=.04	1
		Week 4 (n = 30)			
		Conviction	Preoccupation	Distress	Disruption
Week 4	Conviction	1			
	Preoccupation	0.61 *p*<.01	1		
	Distress	0.69 *p*<.01	0.81 *p*<.01	1	
	Disruption	0.30 *p*=.11	0.38 *p*=.04	0.41 *p*=.02	1
		Week 8 (n = 32)			
		Conviction	Preoccupation	Distress	Disruption
Week 8	Conviction	1			
	Preoccupation	0.69 *p*<.01	1		
	Distress	0.73 *p*<.01	0.85 *p*<.01	1	
	Disruption	0.57 *p*<.01	0.63 *p*<.01	0.70 *p*<.01	1

Table A.4

Pearson correlations of delusional dimensions on PQ at each time point

		Week 0 (n = 38)			
		Conviction	Preoccupation	Distress	Disruption
Week 0	Conviction	1			
	Preoccupation	0.30 *p*=.07	1		
	Distress	0.05 *p*=.78	0.36 *p*=.03	1	
	Disruption	0.25 *p*=.14	0.16 *p*=.34	0.24 *p*=.15	1
		Week 1 (n = 36)			
		Conviction	Preoccupation	Distress	Disruption
Week 1	Conviction	1			
	Preoccupation	0.33 *p*=.05	1		
	Distress	0.21 *p*=.22	0.63 *p*<.01	1	
	Disruption	0.35 *p*=.03	0.60 *p*<.01	0.48 *p*<.01	1
		Week 2 (n = 36)			
		Conviction	Preoccupation	Distress	Disruption
Week 2	Conviction	1			
	Preoccupation	0.52 *p*<.01	1		
	Distress	0.31 *p*=.07	0.77 *p*<.01	1	
	Disruption	0.64 *p*<.01	0.69 *p*<.01	0.54 *p*<.01	1
		Week 4 (n = 30)			
		Conviction	Preoccupation	Distress	Disruption
Week 4	Conviction	1			
	Preoccupation	0.71	1		

		p<.01			
	Distress	0.72	0.82	1	
		p<.01	p<.01		
	Disruption	0.66	0.68	0.73	1
		p<.01	p<.01	p<.01	
		Week 8 (n = 32)			
		Conviction	Preoccupation	Distress	Disruption
Week 8	Conviction	1			
	Preoccupation	0.79	1		
		p<.01			
	Distress	0.56	0.70	1	
		p<.01	p<.01		
	Disruption	0.63	0.70	0.69	1
		p<.01	p<.01	p<.01	

Consistent with VAS, delusional dimensions on PSYRATS and PQ were correlated with each other at most time points, and especially strongly at the later time points.

A.1.2 Changes in delusional dimensions

Changes in delusional dimensions on PSYRATS are shown in Figure A7.1. Using the maximum likelihood method, the effects of Time and Dimension, and the Time x Dimension interaction on the PSYRATS scores were tested in a linear mixed model (AIC = 1982.92, BIC = 2078.50). There was a significant effect of Time (F = 26.13, df = 1, p < .01), Dimension (F = 23.23, df = 3. p < .01), and Time x Dimension interaction (F = 6.32, df = 3, p < .01). It should be noted, however, that the assumption of normality of residuals is not met for two dimensions and some of the time points. Therefore, the results of this mixed model should be interpreted with caution.

Figure A.1

Changes in PSYRATS delusional dimensions (N = 40)

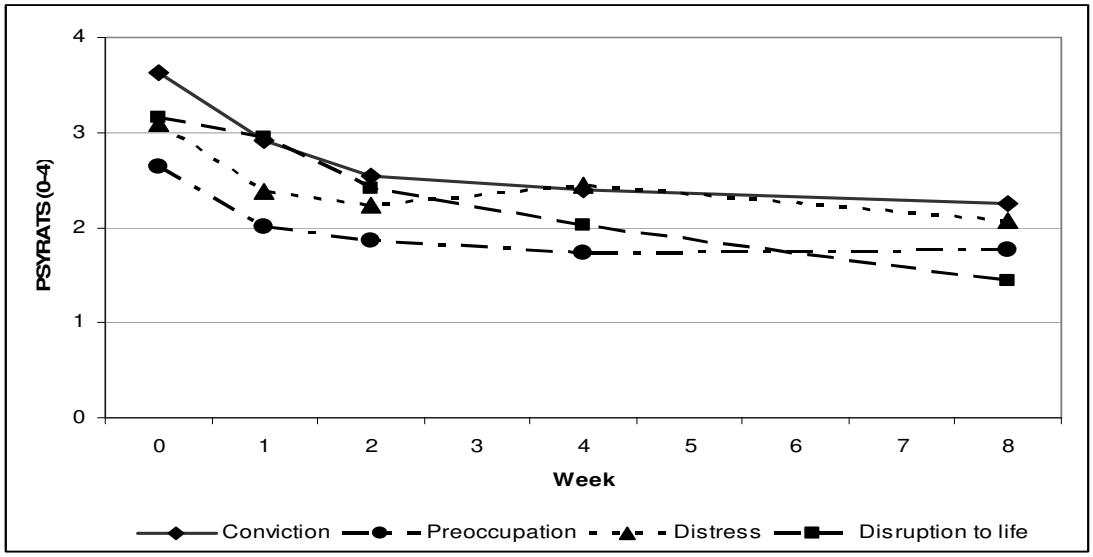
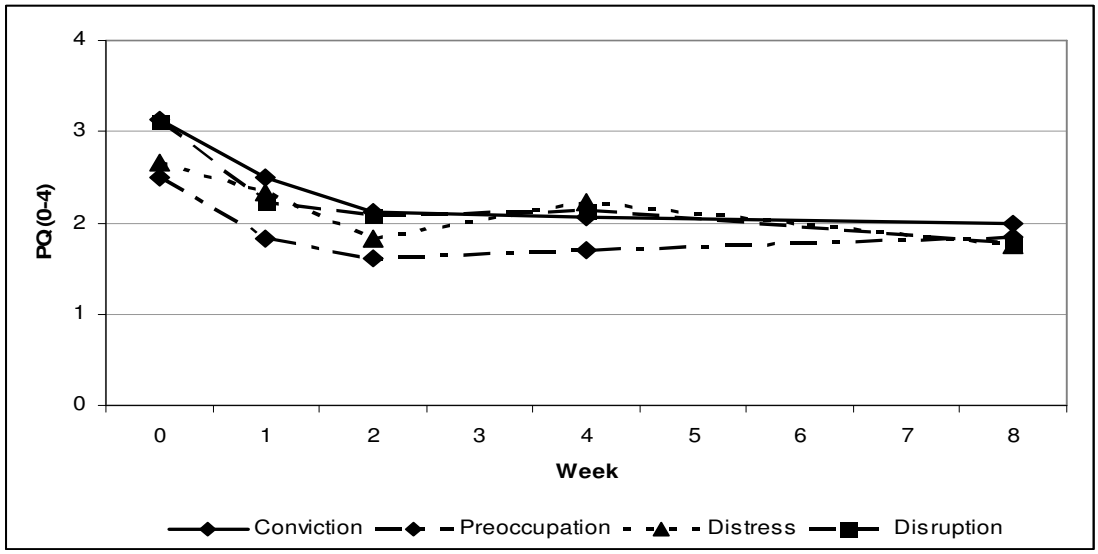


Figure A.2

Changes in PQ delusional dimensions (N = 40)



Changes in delusional dimensions on PQ are shown in Figure A.2. Using the maximum likelihood method, the effects of Time and Dimension, and the Time x Dimension interaction on the PQ scores were tested in a linear mixed model (AIC = 2166.06, BIC = 2261.27). There was a significant effect of Time ($F = 16.27$, $df = 1$, $p < .01$) and Dimension ($F = 9.82$, $df = 3$. $p < .01$). However, the Time x Dimension interaction effect was not significant ($F = 1.91$, $df = 3$, $p = .13$). Therefore, the interaction effect was removed and a second model with the effects

of Time and Dimension on PQ scores was tested. The model fit indices of the second model (AIC = 2165.70, BIC = 2247.31) indicated a better fit of the data. Again, the effects of Time (F = 15.10, df = 1, p < .01) and Dimension (F = 9.29, df = 3, p < .01) were both significant. In order to check whether the effect of Time is non-linear, a third model with the effects of Dimension, Time, and a quadratic term of time (squared Time) was tested. The model fit indices of the third model (AIC = 2157.14, BIC = 2243.29) indicated a better fit of the data than the previous two models. In other words, all dimensions declined over time, and the reduction became smaller over time. There was a significant difference between dimensions, but there was no interaction between dimensions and time. Therefore, the hypothesis that delusional conviction reduces more slowly or to a lesser degree than the other dimensions was not supported. The assumption of normality of residuals is met for all dimensions and time points.

Pair-wise comparisons between dimensions were tested, based on estimated marginal means in the same model (i.e. the third model). With Bonferroni adjustment for multiple comparisons, level of Preoccupation was significantly lower than Conviction (difference = -0.48, SE = 0.10, df = 172.00, p < .01), Distress (difference = -0.26, SE = 0.09, df = 172.00, p = .03), and Disruption (difference = -0.38, SE = 0.10, df = 172.00, p < .01).

In summary, mixed modelling analyses of all three measures revealed a decline in all delusional dimensions over time. While there was an interaction between time and dimension for PSYRATS (i.e. dimensions improving at different rates), this result should be interpreted with caution because the assumption of normality of residuals is not satisfied. Besides, the scoring of the PSYRATS item on Disruption to life depends heavily on whether the patient is in hospital. When disruption is assessed by the extent to which the delusion interferes with one's life regardless of where he/she is, as in VAS and PQ, results are consistent that there is no interaction between time and dimension. To conclude, these results suggest that all dimensions improve equally over time, and the hypothesis that conviction improves more slowly or in a lesser degree is not supported.